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Formación en Soporte Vital Básico en centros escolares.

Dna. Cristina Jorge Soto

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A miña familia

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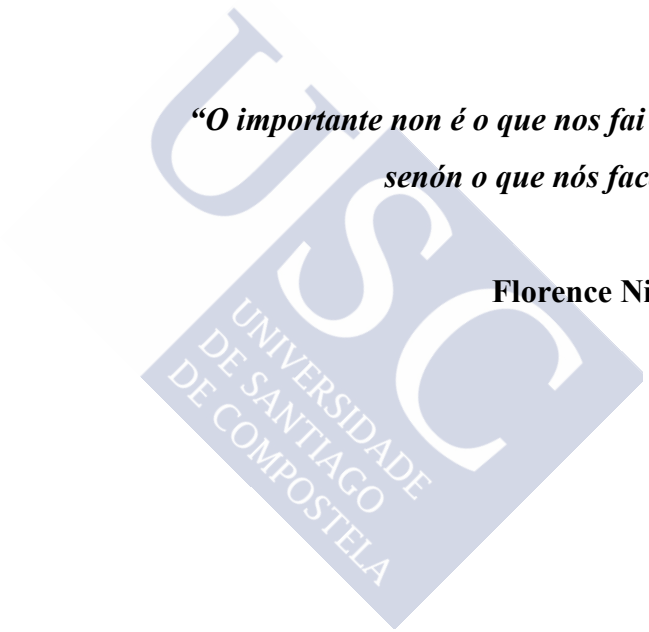
"O importante non é o que nos fai o destino,
senón o que nós facemos del"

Florence Nightingale



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RESUMEN.

Formación en Soporte Vital Básico en Centros Escolares.

INTRODUCCIÓN

La parada cardiaca (PC) es la interrupción repentina, inesperada y potencialmente reversible de la circulación y la respiración espontáneas (1).

En 1981 Peter Safar, conocido como el padre de la resucitación cardiopulmonar (2), definió la "*muerte súbita cardiaca*" como una *"parada cardiaca repentina, sin síntomas previos o con síntomas de menos de una hora de duración"* (3). Para muchos sujetos, la muerte súbita cardiaca es la primera manifestación de una enfermedad cardiovascular (4,5).

Los últimos registros muestran que las enfermedades cardiacas y del sistema circulatorio son la principal causa de muerte en Europa, responsables del 45 % de los fallecimientos. Concretamente la isquemia cardiaca es la principal causa de muerte prematura [por debajo de los 65 años de edad] tanto en hombres como en mujeres (6,7).

La PC afecta alrededor de entre 350.000 – 700.000 individuos al año en Europa (8) y, los registros europeos han mostrado que en torno a 275.000 ocurren fuera del hospital (9). Actualmente la parada cardiaca extrahospitalaria [PCEH] es la tercera causa de muerte en los países industrializados (10). Más del 70 % de las PCEH son presenciadas y a pesar de que la asistencia por parte de los testigos puede mejorar la supervivencia y disminuir las secuelas, las cifras de reanimación cardiopulmonar iniciadas por testigos se encuentran por debajo del 20 % en la mayoría de los países (11-17).

Debido al importante número de casos y al impacto socioeconómico que supone, la muerte súbita cardiaca representa uno de los principales retos de la medicina moderna (17).

La cadena de supervivencia fue publicada por primera vez en las Guías para la Resucitación del Consejo Europeo de Resucitación [ERC] (18,19) en el año 2005. Se basa en el concepto de que la supervivencia tras una PC depende de una secuencia ordenada de intervenciones entrelazadas y resalta la importancia de que cada uno de los pasos se realice de forma óptima (en

tiempo y calidad) para incrementar las posibilidades de supervivencia sin alteraciones neurológicas (19-21).

La contribución de estas intervenciones al incremento de las posibilidades de supervivencias se reduce conforme las víctimas de PC perecen en cada uno de los eslabones (21,23,24). Además, se ha observado que no todos los eslabones tienen la misma repercusión en la supervivencia de la víctima. Por este motivo, en mayo de 2018, el ERC propuso una alternativa a la representación gráfica clásica de la cadena de supervivencia. Esta nueva propuesta muestra eslabones que se reducen en tamaño conforme se avanza a lo largo de la cadena (21). La intención no es reemplazar el modelo "clásico", la cual es todavía la más recomendada para la formación de la población. El objetivo de esta representación es informar a la comunidad científica donde se encuentra el mayor potencial para mejorar la supervivencia y, por tanto, hacia dónde se deben dirigir las acciones de mejora. Así, si la población no está entrenada en reconocer de manera precoz la PC, activar los servicios de emergencias e iniciar compresiones torácicas con calidad, poco útil puede resultar saber utilizar un desfibrilador.

En el momento en que se produce la PC, los ritmos desfibrilables pueden estar presentes hasta en el 50 % de los casos en adultos. En estos casos la recuperación de un ritmo de perfusión puede ser conseguida mediante una desfibrilación eléctrica, que cuadruplica las posibilidades de supervivencia cuando es aplicada en los primeros 3-5 minutos tras el inicio de la PC (8,26-28).

El desfibrilador externo semiautomático (DEA o DESA) es un dispositivo sencillo y seguro capaz de analizar el ritmo cardiaco y proporcionar una descarga eléctrica en caso indicado (31). Se entiende por desfibrilación temprana aquella que se produce en los primeros 3-5 minutos tras el inicio del colapso y consigue cifras de supervivencia entorno al 50-70 %. La comunidad científica recomienda la formación de la población en el uso del DEA y la implantación de estos dispositivos en lugares donde son habituales las multitudes como aeropuertos, colegios o estadios deportivos (8,34,35).

La intervención de los testigos en la PCEH en crucial para mejorar la supervivencia y reducir la aparición de secuelas (41-46).

El diseño simple de los DEA hace que cualquier persona pueda utilizarlos correctamente independientemente de su edad, nivel de estudios o presencia de diversidad funcional o discapacidad. Estudios preliminares han mostrado que jóvenes con síndrome de Down son capaces de aprender

a utilizar un DEA y realizar una desfibrilación temprana en un escenario simulado (48,49). Del mismo modo, se ha observado que la discapacidad visual puede no ser un obstáculo para utilizar correctamente un DEA tras un entrenamiento breve (50).

Los entrenamientos breves en soporte vital básico (SVB) son útiles para mejorar el conocimiento y las habilidades tanto de adultos como de niños en edad escolar (55,56). Este tipo de entrenamientos facilitan el acceso a la formación, así como los reentrenamientos periódicos (14,57,58). Además, la retroalimentación (corrección) en tiempo real (feedback) y el autoaprendizaje parecen ser herramientas útiles para reforzar la formación (59-65).

Los niños son considerados una población diana para la formación en SVB, están situados en una etapa en la que resulta muy fácil adquirir nuevos conceptos y además su entrenamiento debería garantizar un número importante de posibles primeros intervinientes en el futuro (75,78,79). De este modo, los colegios han sido señalados como el entorno perfecto donde comenzar la formación en SVB, de hecho, el entrenamiento en los colegios presenta el mayor impacto en el incremento de la tasa de intervención por parte los testigos (14,41,75,78-82). Aunque todavía no está del todo claro qué profesional debería encargarse de impartir esta formación, la inclusión de los profesores como un elemento clave en la formación en SVB ha sido apoyada por iniciativas internacionales como Kids Saves Lives ("los niños salvan vidas") [KSL] (67-76) y locales como el proyecto ANXOS (Adestrando a Nenos e Xóvenes a Salvar vidas) (77).

Estudios previos han mostrado que los profesores están dispuestos a impartir esta formación y el entrenamiento en SVB proporcionado por profesores entrenados es tan efectivo como el entrenamiento proporcionado por profesionales sanitarios (55,56,73,74,83-86).

El entrenamiento a los escolares en SVB debe formar parte de estrategias dirigidas a incrementar la atención de la PC por parte de los testigos. Esta formación debe comenzar a edades tempranas adaptando el entrenamiento a las características y la etapa escolar de los alumnos (87,88).

HIPÓTESIS:

- El DEA es un dispositivo conocido para los estudiantes de educación primaria y secundaria, con edades comprendidas entre los 6 y los 16 años.
- Los niños en edad escolar son capaces de utilizar correctamente el DEA siguiendo únicamente su intuición, sin recibir información o indicaciones previas.
- Un video formativo breve es útil para que los escolares aprendan a utilizar correctamente un DEA y la retención de las habilidades aprendidas al cabo de un mes.
- Los jóvenes con síndrome de Down son capaces de aprender cómo se utiliza un DEA tras una sesión formativa teórica y práctica breve acompañado de la visualización de un video formativo.
- Los estudiantes universitarios de Ciencias de la Educación y del Deporte tienen un conocimiento deficiente en soporte vital básico.
- Los futuros profesores de educación primaria y secundaria están dispuestos a formar a sus alumnos en soporte vital básico.
- Una breve sesión formativa en soporte vital básico acompañada con correcciones a tiempo real es útil para mejorar las habilidades en RCP y los conocimientos de estudiantes universitarios de Ciencias de la Educación y el Deporte.

OBJETIVOS:

Los objetivos principales de esta investigación son:

1. Analizar la habilidad de los estudiantes de primaria y secundaria para utilizar un DEA, en menos de 3 minutos y de manera intuitiva, tras la visualización de un video formativo breve, de inmediato y un mes después de la formación.
2. Evaluar la utilidad de los entrenamientos muy breves en SVB para mejorar el conocimiento y las habilidades en RCP y desfibrilación de estudiantes universitarios de Ciencias de la Educación.

Los objetivos secundarios de esta investigación son los siguientes:

1. Investigar si el DEA es un dispositivo conocido para los estudiantes de educación primaria y secundaria con edades comprendidas entre los 6 y los 16 años.

2. Evaluar el uso intuitivo del DEA por parte de estudiantes de educación primaria y secundaria.
3. Analizar si la variable edad está relacionada con un mejor uso del DEA en los escolares y comparar los conocimientos y habilidades en desfibrilación según su etapa educativa.
4. Determinar si un video formativo simple es suficiente para que los escolares aprendan a utilizar un DEA en menos de 3 minutos y retengan las habilidades aprendidas al cabo de un mes.
5. Investigar si los jóvenes con síndrome de Down son capaces de aprender a utilizar correctamente un DEA después de una sesión formativa breve teórica y práctica.
6. Evaluar los conocimientos en soporte vital básico de los futuros profesores de Educación Física.
7. Determinar el efecto que produce un entrenamiento muy breve en soporte vital básico acompañado de correcciones a tiempo real sobre el aprendizaje de estudiantes universitarios.

RESULTADOS:

Esta tesis se presenta bajo la modalidad de compendio de publicaciones, por ello, los resultados se presentan como artículos de investigación. Dichos artículos son los siguientes:

1. Habilidades en desfibrilación de niños en edad escolar sin formación previa. (*Automated external defibrillation skills by naïve schoolchildren*) (109).

El objetivo de este estudio fue evaluar el uso del DEA por parte de escolares sin recibir formación previa o indicaciones durante la intervención. Para ello se realizó un estudio multicéntrico en el que participaron 1295 estudiantes con edades comprendidas entre los 6 y los 16 años sin formación previa en SVB. Los participantes realizaron una simulación con DEA de entrenamiento y maniquí que fue evaluada mediante una lista de comprobación específica.

Un total de 258 (19.9 %) participantes realizaron un uso correcto y seguro del desfibrilador en menos de 3 minutos. El coeficiente gamma mostró una pequeña pero significante relación entre la desfibrilación correcta y el grupo de edad (G= 0,172) (p< 0,001). A partir de los 9 años,

casi uno de cada cuatro participantes consiguió el objetivo de descarga efectiva.

Cincuenta y dos (20,1 %) de los 258 participantes que alcanzaron el objetivo de descarga consiguieron también el objetivo de calidad. Aunque el coeficiente gamma mostró una relación directa entre el objetivo de calidad y el grupo de edad, el resultado no fue estadísticamente significativo (G=0,150) (p=0,152).

En cuanto a los errores cometidos durante el uso del DEA, el más cometido fue la alteración del orden de ejecución [197/258 (76.4 %)] seguido del intercambio de los parches [37/258 (14.3%)].

Se analizó el tiempo en los 258 participantes que alcanzaron el objetivo de "descarga efectiva". La media fue de 83.3 $\pm$ 24.6 segundos. El tiempo para la desfibrilación se redujo conforme la edad aumentaba [6 años (108.3 $\pm$ 40.4) vs. 16 años (64.7 $\pm$ 18.6)] ($p< 0.001$). En el análisis por pares post hoc encontramos que el tiempo medio fue significativamente menor para los estudiantes más mayores ($p< 0,001$ en todos los contrastes) y además no se encontraron diferencias significativas entre los grupos de estudiantes más jóvenes (de 6 a 10 años) y tampoco entre los más mayores (de 12 a 16 años).

Este estudio presenta algunas limitaciones. El test fue realizado bajo condiciones simuladas por lo que los resultados obtenidos probablemente no son los mismos que los que se obtendrían en una situación real. El cuestionario de conocimientos previos incluyó preguntas sobre cómo los escolares habían adquirido ciertos conocimientos sobre el DEA (familiares, redes sociales, etc).

En conclusión, alrededor del 20 % de los escolares sin formación previa son capaces de utilizar correctamente un DEA en menos de 3 minutos siguiendo las indicaciones acústicas y visuales del dispositivo. Sin embargo, sólo una quinta parte de los que tuvieron éxito lograron completar el procedimiento satisfactoriamente.

2. Aprendizaje del uso del desfibrilador semiautomático mediante métodos audiovisuales en escolares (106).

El objetivo este estudio fue evaluar la habilidad de los escolares para utilizar un DEA correctamente y conseguir una desfibrilación efectiva y la retención del aprendizaje al cabo de un mes tras la formación, basada en el uso de medios audio-visuales.

Se llevó a cabo un estudio quasi-experimental con 205 estudiantes sin formación previa con edades comprendidas entre los 6 y los 16 años. Se utilizaron DEAs de entrenamiento maniquís. Los estudiantes realizaron una prueba inicial (T0) de habilidad, y luego fueron asignados al azar a un grupo experimental o de control en la primera fase (T1). El grupo experimental vio un video de entrenamiento y después se evaluó nuevamente a ambos grupos. Al cabo de un mes se realizó el último test práctico (T2).

La muestra final la formaron 196 participantes y todos fueron capaces de simular una descarga en menos de 2 minutos. Los conocimientos sobre el DEA fueron mejores en los estudiantes de secundaria, así 96 (95 %) participantes de secundaria sabían qué era un DEA, en contraste con 54 (56,8 %) estudiantes de primaria ($p<0,001$). Por otro lado, veinte (19.8 %) estudiantes de secundaria afirmaron saber cómo utilizar un DEA frente a 8 (8,4 %) de primaria ($p=0,023$). No se encontraron diferencias significativas entre el grupo experimental y el grupo control para el objetivo de descarga efectiva ni para el objetivo de calidad tanto en primaria como secundaria.

Tras la actividad formativa, que consistió en visualizar un video breve y sencillo, el número de participantes del grupo experimental que alcanzaron el objetivo de descarga efectiva fue el doble que los del grupo control en primaria [Control: 14 (29.8 %) vs. Experimental: 30 (62.5 %), $p<0.001$]. En cuanto al objetivo de calidad, el grupo experimental alcanzó mejores resultados tanto en primaria [Control: 1 (7.1 %) vs. Experimental: 13 (43.3 %), $p=0.018$] como en secundaria [Control: 3 (13.6 %) vs. Experimental 12 (46.2 %), $p=0.017$].

En cuanto a la prueba de retención, el logro del objetivo de desfibrilación de los estudiantes de primaria fue similar para ambos grupos, pero el grupo experimental empeoró en cuanto al objetivo de calidad. Todos los estudiantes de secundaria mejoraron en el objetivo de desfibrilación, pero el grupo de control obtuvo peores resultados para el objetivo de calidad [Control: 0 vs. Experimental: 9 (28,1 %), $p=0,001$].

Referente al análisis del tiempo, fue menor en los grupos de secundaria y se fue reduciendo en cada una de las etapas del estudio.

Este estudio presenta ciertas limitaciones. Todos los participantes fueron reclutados en el mismo centro escolar; por lo tanto, es posible que haya algún sesgo de selección con respecto a las características sociales, culturales y económicas.

En conclusión, los estudiantes de secundaria que no han recibido formación previa saben lo que es un DEA y la mitad de ellos pueden utilizarlo en simulación. Un video formativo breve mejora la habilidad para manejar un DEA y les ayudan a retener lo que aprendieron para su uso posterior.

3. Profesores como candidatos para enseñar soporte vital básico: un studio de simulación. (*Schoolteachers as candidates to be basic life support trainers: A simulation trial*) (88).

El objetivo de este estudio fue evaluar el conocimiento en SVB de los futuros profesores de primaria y secundaria y su disposición para incluir estos contenidos en sus futuras lecciones además de determinar el efecto de una sesión de entrenamiento breve y práctico apoyado con *feedback* a tiempo real.

Se reclutó una muestra de 98 estudiantes universitarios de Ciencias de la Educación y del Deporte. El programa de entrenamiento consistió en una breve sesión interactiva teórica y práctica con una relación instructor/ participantes de 2/10. El conocimiento y la disposición se evaluaron mediante una encuesta. Las compresiones torácicas y la calidad de la ventilación se registraron en 47 casos durante un test de un minuto de reanimación cardiopulmonar.

En el estudio participaron 98 estudiantes de Ciencias de la Actividad Física y del Deporte. Cincuenta y nueve (62 %) participantes declararon haber recibido entrenamiento en RCP antes del estudio.

Todos los participantes afirmaron saber que es la RCP y el 58 % declaró saber cómo realizar una RCP en adultos.

El conocimiento de los estándares de calidad de la RCP fue deficiente inicialmente, pero después del entrenamiento, el conocimiento mejoró en todos los conceptos (relación compresión/ventilación, velocidad de compresión y profundidad de compresión).

El porcentaje de participantes que sabían lo que es un DEA aumentó del 87,8 % antes del entrenamiento al 100 % después del entrenamiento, también el número de participantes que declararon saber cómo usar un DEA (38,8 % antes de la prueba vs. 100% después de la prueba). La mayoría de los sujetos declararon estar dispuestos a utilizar un DEA en una situación de emergencia, tanto antes de la prueba (70,4 %) como después de la prueba (98 %).

El 85 % de la muestra consideró que una materia específica de Primeros Auxilios es importante para su formación en la universidad y el 78,6 % declaró que esta materia debería ser obligatoria. La mayoría de ellos estarían dispuestos a incluir este contenido en proyectos o unidades didácticas con sus estudiantes (pre-test 71.4% vs. post-test 76.5%).

Durante la prueba práctica, más del 80% de las compresiones torácicas (CC) se realizaron a un ritmo adecuado y todas se realizaron con posición de manos correcta. La profundidad de compresión correcta [50-60 mm] fue alcanzada por ambos grupos, hombres y mujeres. La reexpansión del tórax fue mejor en mujeres

(Mujeres: 72.2 + 32.8 % vs. Hombres: 45.4 $\pm$ 32.9 %, p=0.009) y el grupo de hombres realizó compresiones más profundas (Hombres: 56.1 $\pm$ 4.03 mm vs. Mujeres: 52.17 $\pm$ 5.51 mm, p=0.007).

Este estudio presenta algunas limitaciones. La prueba se realizó en condiciones de simulación y con maniquíes en lugar de pacientes reales, por lo que es probable que los resultados no sean los mismos que los que se obtendrían en una situación real. De todos modos, es evidente que este tipo de estudios no pueden realizarse con víctimas reales. Los conocimientos y habilidades de los participantes fueron evaluados inmediatamente después de la formación, por lo tanto, no podemos determinar la utilidad de esta actividad formativa para la retención del aprendizaje a corto o medio plazo.

En conclusión, una formación práctica breve respaldada por *feedback* a tiempo real sobre la calidad de RCP ayuda a los futuros profesores a mejorar sus conocimientos, su confianza en sí mismos y sus habilidades en RCP. El entrenamiento en SVB debería incluirse en el currículum universitario de los futuros profesores para promover su compromiso con la formación en SVB de los escolares.

4. Entrenamiento muy breve en desfibrilación externa semiautomática para personas con Síndrome de Down. (*Brief training in automated external defibrillation use for person with down syndrome*) (49).

El objetivo del estudio fue evaluar las habilidades de desfibrilación de los jóvenes con síndrome de Down después de un programa de entrenamiento muy breve y sencillo.

Invitamos a miembros y personal de la Fundación Down Compostela a participar en un breve programa de formación: 5 minutos de explicación sencilla, visualización de un video breve y cómico y 20 minutos de

entrenamiento práctico. Después del entrenamiento, cada participante fue evaluado individualmente en un escenario simulado, la práctica fue evaluada por medio de una lista de comprobación que incluía tres temas principales: tiempo hasta la desfibrilación, objetivo de desfibrilación efectiva y objetivo de la calidad.

Se incluyeron 39 participantes, 27 jóvenes con síndrome de Down (SD) y 12 terapeutas ocupacionales (TO). El 52 % de las personas con SD eran hombres, la edad media del grupo fue de 26,4 $\pm$ 5,3 años. El grupo de TO estaba formado por un 92 % de hombres y la edad media fue de 43,8 $\pm$ 17,6 años. Los grupos fueron significativamente diferentes por edad y sexo ($p < 0,001$).

Todos los TO y 17/22 (63 %) de los participantes con SD cumplieron el objetivo de desfibrilación ($p = 0,014$). El objetivo de calidad fue obtenido por 11 (91,6 %) TO y 8 (47 %) participantes con SD ($p = 0,013$). El tiempo hasta la desfibrilación fue de 50,3 $\pm$ 8 segundos en el grupo de OT y 74,5 $\pm$ 15 segundos en el grupo de SD ($p < 0,001$).

Debemos exponer ciertas limitaciones que presenta este estudio. La participación era voluntaria; por lo tanto, podría existir un posible sesgo de selección si los voluntarios fueron los jóvenes con SD con mejor funcionalidad. En este sentido, nuestros resultados sólo se refieren a sujetos con SD con buena funcionalidad y no a personas con discapacidades graves. Además, nuestros resultados pueden estar sesgados por la metodología de formación innovadora y no validada que se ha aplicado

En conclusión, después de una formación sencilla y breve, la mayoría de los jóvenes con SD son capaces de utilizar un DEA en menos de dos minutos, aunque no alcanzan el mismo nivel de rendimiento que otros ciudadanos.

DISCUSIÓN.

Los escolares han sido señalados como una población diana esencial para la formación en SVB y el incremento de la tasa de inicio de la reanimación por los testigos (14,34,75,78,79,105). Sin embargo, estos niños no han sido estudiados de una manera sistemática y existen dudas sobre ciertos aspectos de su formación como a qué edad son capaces de aprender a utilizar un DEA, su conocimiento sobre el dispositivo o qué profesional sería el más adecuado para impartir esta formación.

Iniciativas internacionales como Kids Save Lives, respaldada por el ERC, tratan de facilitar la inclusión de la formación en RCP básica en los centros escolares a través de entrenamientos prácticos, sencillos y breves, aprovechando la figura del profesor como instructor o guía durante el entrenamiento.

En cuanto al conocimiento del dispositivo, en el momento de realizar este estudio no se habían encontrado referencias previas sobre el nivel de conocimientos de los escolares sobre el DEA. Por tanto, nuestro estudio, que fue el primero en abordar esta cuestión, muestra que 3 de cada 4 escolares afirmaron saber qué es un DEA, a pesar de no haber recibido formación previamente.

Actualmente se pueden encontrar múltiples referencias al SVB y el uso del DEA en las redes sociales, películas, videos de internet, etc (108) y además los DEA son elementos presentes en muchos lugares públicos como aeropuertos o centros comerciales. Por lo tanto, es posible que un número significativo de escolares haya adquirido cierto conocimiento de manera indirecta acerca de la importancia de la desfibrilación precoz y el uso del DEA. Este hecho es relevante ya que significa que este dispositivo no resulta desconocido para los escolares españoles y esto puede suponer un buen punto de partida para la formación.

El diseño sencillo y homogéneo de los DEAs debería permitir que sean utilizados por cualquier persona de forma efectiva y segura sin necesidad de formación previa.

El estudio " Automated external defibrillation skills by naïve schoolchildren " (109), ha sido el primero en evaluar el uso intuitivo del DEA en una muestra muy grande (1295 escolares no entrenados previamente) con un rango de edad amplio (de 6 a 16 años). Dicha investigación, mostró que sólo el 8,7 % de los alumnos de 6 años utilizaron el DEA correctamente; alrededor del 25 % del grupo de 9 años logró el objetivo y este porcentaje aumentó hasta el 33,3 % para el grupo de 16 años. En cuanto a la calidad, en los subgrupos que alcanzaron el objetivo de desfibrilación, sólo el 11,1 % del grupo de 6 años realizó la prueba sin errores, mientras que casi el 25 % de los sujetos del grupo de 10 años y más del 50 % del grupo de 16 años alcanzaron el objetivo de calidad. Así, los resultados del estudio indican que, a partir de los 9 años, uno de cada 4 escolares es capaz de aplicar el DEA de forma intuitiva, y a los 16 años la mitad de los estudiantes capaces son capaces de completar el procedimiento con calidad. Según nuestros resultados, los niños de 9 a 14 años tienen un nivel similar de conocimientos y habilidades para utilizar un

DEA, lo que sugiere que alrededor de los 9 años puede ser la edad en la que los niños deberían empezar a formarse en el uso del DEA, adaptando las actividades de formación y reciclaje a las características de los niños de diferentes edades.

Estudios previos, realizados en otros países y con muestras más pequeñas, obtuvieron resultados comparables. En 1999, Gundry y cols. compararon el uso de DEA por escolares no entrenados (de 9 años de edad) con profesionales sanitarios y observaron que todos los participantes colocaron adecuadamente los electrodos y realizaron la prueba con seguridad durante la descarga (111). En otro estudio en el que participaron 47 escolares de entre 6 y 7 años de edad, ocho alumnos (17 %) identificaron correctamente el orden de ejecución y, tras una semana de formación, el número de alumnos aumentó hasta 24 [51 %] (112). El uso de DEA por niños muy pequeños sin entrenamiento fue evaluado también por Lawson y cols. en este estudio se observó que escolares de 9 años de edad sin formación previa en el uso de DEA fueron capaces de utilizarlo correctamente antes del entrenamiento y el tiempo hasta la primera descarga se redujo tras la formación (113). Younas y cols. (60) observaron que estudiantes (13-16 años de edad) con formación previa en primeros auxilios obtuvieron mejores resultados que los estudiantes no entrenados (grupo de control) para todas las habilidades evaluadas: 1) verificar el estado de conciencia y la respiración, 2) RCP, 3) uso de DEA. El uso de DEA fue la parte peor realizada del algoritmo (27% de los estudiantes de entrenamiento vs. 4% del grupo de control).

Por tanto, nuestro estudio y los previamente citados, apoyan que, aunque debido a su sencillez el DEA pudiera ser utilizado correctamente en condiciones simuladas sin entrenamiento previo, es necesario realizar programas de formación breves para optimizar su uso en una situación estresante como es una urgencia médica.

Nos ha sorprendido la capacidad de los escolares para manejar el dispositivo siguiendo las instrucciones que proporciona, esta facilidad puede estar relacionada con la familiarización que este colectivo tiene con los dispositivos electrónicos. Este hecho debe ser tenido en cuenta, ya que nos indica que la capacidad de los escolares no supone un problema para el manejo del DEA. Por lo tanto, es los programas de entrenamiento el tiempo dedicado a los DEA puede ser breve, dedicando más tiempo a aspectos más problemáticos, como la calidad de las compresiones torácicas.

Cada minuto que pasa tras una PC sin realizar ninguna intervención, las posibilidades de supervivencia disminuyen en aproximadamente un 10-12

%, mientras que la supervivencia aumenta significativamente cuando se aplica un DEA en los primeros minutos después del colapso (8).

En nuestra muestra de escolares, el tiempo de desfibrilación fue inferior a 3 minutos en todos los casos y disminuyó a medida que aumentaba la edad (6 años: 108,3 segundos frente a 16 años: 64,7 segundos). Es importante destacar que todos los niños mayores de 8 años terminaron la prueba en menos de 2 minutos. Inmediatamente después de un entrenamiento muy breve (vídeo formativo), el tiempo de desfibrilación disminuyó en menos de 70 segundos tanto en el grupo control como en el experimental y en menos de 55 segundos un mes después del entrenamiento. Por tanto, el tiempo de desfibrilación disminuye después de un entrenamiento muy breve, pero también con el uso repetido del dispositivo (119).

Las personas con síndrome de Down están cada vez más integradas en la sociedad y se esfuerzan por demostrar sus capacidades y conseguir ser considerados como cualquier otro ciudadano. En ese sentido, son un colectivo de personas dispuestas a aprender y ser útiles a la sociedad.

En el estudio que ha evaluado las habilidades de los jóvenes con síndrome de Down, el 63 % de los participantes pudieron lograr una desfibrilación efectiva después de participar en un entrenamiento breve y el 47 % de ellos lo hicieron con calidad. El tiempo medio hasta la desfibrilación fue de unos 75 segundos (49). Otras poblaciones de discapacitados han sido estudiadas en relación con sus habilidades BLS, como un estudio contemporáneo en el que participaron veintisiete voluntarios ciegos. Este estudio muestra que, después de un programa de entrenamiento práctico adaptado de una hora de duración, 20 de cada 27 (74,1%) podrían realizar una desfibrilación efectiva en un tiempo medio de 65 ± 27 segundos.

Estudios previos realizados en escolares sin formación han mostrado resultados similares. Esto sugiere que los estudiantes y los jóvenes tienen una intuición acerca de la importancia del factor tiempo en la atención en caso de una PC.

El entrenamiento a la población es necesario para aumentar la RCP iniciada por testigos y mejorar la supervivencia y las secuelas tras una PCEH. Aunque los centros escolares son señalados como el entorno ideal para la formación en SVB, no está claro qué profesional es el más adecuado para impartir esta formación.

En el estudio "*Schoolteachers as candidates to be basic life support trainers: A simulation trial*" (88) se muestra que un entrenamiento muy breve tiene un efectivo positivo sobre la adquisición de conocimientos y la disposición para impartir estos contenidos de los estudiantes de Ciencias de la Educación y el Deporte.

En aquellos países en los que la formación en RCP forma parte del currículum escolar, la RCP iniciada por testigos se realiza en más del 40% de las PCEH y se asocia con una supervivencia del doble o el triple. La necesidad de instructores certificados puede suponer una barrera para implementación de esta formación en los centros escolares. Por ello, se ha señalado a los propios profesores del centro para que se encarguen de impartir estos contenidos.

Investigaciones previas han demostrado que los profesores de educación primaria, previamente entrenados por instructores profesionales, pueden enseñar SVB de una manera efectiva y que incluso obtienen mejores resultados formativos que los propios profesionales sanitarios (55,73,74,83-86,120-122). Se puede suponer que los profesores tienen habilidades y experiencia práctica en la educación de sus alumnos y pueden obtener mejores resultados que los instructores profesionales que no cuentan con una formación específica en metodología docente.

Una estrategia útil para mejorar la inclusión de esta formación en el currículum escolar es poner en práctica programas formativos breves, atractivos y sencillos que no generen grandes interrupciones en la planificación habitual. Este tipo de entrenamiento ha resultado efectivo tanto con adultos como con escolares y han obtenido resultados similares a actividades formativas de más de una hora de duración. Esta metodología es la seguida por un proyecto gallego, el Proyecto Anxos (77), que tiene como objetivo la difusión de la RCP entre los escolares (los adultos del futuro) y concienciar de la importancia de la reanimación iniciada por testigos en el contexto de una PC. El programa didáctico empleado se basa principalmente en la práctica y cuenta con recursos educativos como cuentos o material adaptado. Todas las estrategias formativas llevadas a cabo en esta investigación cumplen con el modelo de entrenamiento breve y sencillo.

La edad escolar podría ser la más adecuada para comenzar la formación en SVB. A pesar de ello, la sociedad no ha tomado conciencia de la importancia de empezar a formarse a una edad temprana. Lockey y cols. (137) señalaron en 2013 que sólo unos pocos países han incluido este aspecto en los planes de estudio escolares, incluso cuando los estudios

publicados han demostrado que los niños en edad escolar pueden aprender y conservar las habilidades en SVB tan bien como los adultos o incluso mejor que ellos. En 2018, la formación en RCP en la escuela está legislada en 5 países europeos y solo es una sugerencia en 23 según una encuesta contestada por 31 países europeos (67). Además, la mayoría de los estados de EE.UU. requieren que los estudiantes de secundaria aprendan RCP para poder graduarse (139). La implementación de programas de capacitación en SVB en las escuelas está relacionada con las mayores tasas de desfibrilación temprana en caso de PCEH.

Aunque no está claro a qué edad los escolares son capaces de aprender eficazmente los diferentes aspectos de los primeros auxilios, estudios previos han señalado que la edad mínima para poder realizar la RCP con una calidad similar a la de un adulto es a los 13 años (114). Mientras que alrededor de los 9 años, los niños pueden empezar a formarse en el conocimiento y uso de los DEA (106,107).

La formación temprana en SVB ha sido avalada por iniciativas internacionales en los últimos años, como Kid Save Lives [KSL] (67--76). Así KSL recomienda 2 horas al año de entrenamiento en RCP a partir de los 12 años. Este proyecto sugiere que la formación en RCP sea obligatoria en todos los centros escolares de Europa. La iniciativa KSL fomenta la formación práctica, herramientas como el juego "serio" y las competiciones para difundir el conocimiento de la RCP y mejorar las habilidades de RCP en los niños y el papel del profesor en la formación en SVB. Estos principios concuerdan con los que fundamentaron la realización de esta investigación.

Iniciando la formación a una edad temprana, los niños por un lado aprenderán y no olvidarán cómo salvar una vida y por otro, la tasa de supervivencia de las personas con PCEH podría mejorar, lo que supone una buena inversión de presente y futuro para la salud pública. Como se muestra en la presenta tesis, la formación de los profesores y la difusión de las maniobras de resucitación en los centros escolares no requiere grandes recursos materiales ni personal experto, es la voluntad de los profesores y la motivación de los grupos de investigación lo que permite que iniciativas como la propuesta se hagan realidad.

El trabajo conjunto de los profesores con la comunidad científica podría permitir diseñar programas de formación cada vez más adaptados a los alumnos y al currículo escolar, con el fin de que la formación en soporte vital básico en la escuela no sea algo excepcional sino una realidad común para toda la comunidad educativa.

CONCLUSIONES

1. El DEA es un dispositivo conocido por un porcentaje significativo de la población escolar.

2. En la actualidad, alrededor del 20 % de los escolares sin formación previa pueden aplicar un DEA en menos de 3 minutos, siguiendo las instrucciones acústicas y visuales del DEA. Sin embargo, su conocimiento no es suficiente para realizar la prueba de forma totalmente correcta.

3. Las habilidades para la desfibrilación mejoran con la edad. Los estudiantes de secundaria tienen un mejor desempeño en el uso de DEA y aplican la descarga en un tiempo menor que los estudiantes de primaria.

4. La visualización de un vídeo formativo simple y breve es útil para que los escolares mejoren el uso del DEA y contribuye a la retención a corto plazo de las habilidades aprendidas. Sugerimos incluir esta herramienta formativa en el currículo escolar y aplicarla de manera repetitiva junto con otras actividades docente.

5. Después de un entrenamiento simple y breve, la mayoría de los jóvenes con síndrome de Down son capaces de utilizar un DEA en menos de dos minutos, aunque no alcanzan el mismo nivel de rendimiento que otros ciudadanos. Mirando hacia el futuro, los programas de desfibrilación de acceso público deben ofrecerse no sólo a la población general sino también a las personas con algún grado de discapacidad.

6. Una breve formación práctica apoyada por un sistema de retroalimentación de la calidad de las maniobras en tiempo real ayuda a mejorar el conocimiento y la autoconfianza en las habilidades en SVB y RCP de los futuros profesores. La formación sobre el SVB debería incluirse en los planes de estudios universitarios de los estudiantes de magisterio para promover la participación de estos profesionales en la formación de los escolares en SVB, con el apoyo de iniciativas como Kids Save Lives.

FUTURAS LÍNEAS DE INVESTIGACIÓN.

A raíz de los estudios presentados, hemos podido observar que el desfibrilador es un dispositivo que no resulta desconocido para la población escolar.

En el diseño inicial de la investigación, no consideramos la posibilidad de que los escolares sin formación específica en SVB pudieran conocer el

desfibrilador o tener una idea de para qué se utiliza. Por esta razón, nuestro cuestionario no incluía ninguna pregunta sobre la fuente de este conocimiento previo.

En la actualidad, estamos diseñando un estudio que llevaremos a cabo durante el próximo año en el que evaluaremos la fuente de este conocimiento indirecto que los escolares han adquirido sobre el desfibrilador, la parada cardiaca y la importancia del factor tiempo en la atención a este evento. Nuestra premisa inicial apunta a la televisión y al cine como los elementos que ha difundido este conocimiento entre la población joven, pero no rechazamos otros medios como los videojuegos o las redes sociales.

Como resultado de nuestra experiencia en la formación de jóvenes con síndrome de Down y tras los buenos resultados obtenidos en la adquisición de conocimientos y habilidades tanto en RCP como en el uso del DEA, hemos continuado dirigiendo nuestras actividades formativas a otras poblaciones con diversidad funcional como personas con discapacidad visual. Los resultados preliminares de este proyecto son alentadores.

En los últimos 2 años hemos llevado a cabo el entrenamiento en SVB de grupos reducidos de adultos con algún tipo de discapacidad visual, tanto ceguera total como parcial. La metodología seguida ha consistido en programas formativos muy breves y fundamentalmente prácticos, de la misma manera que se hace con las poblaciones sin discapacidad. La característica principal de nuestro programa de formación es que los participantes estaban siempre en contacto con el material docente (maniquí y desfibrilador de formación). Por lo tanto, en esta actividad, se ha dado especial relevancia al tacto como medio para que los participantes comprendan cada paso del algoritmo del SVB.

Este estudio evaluó la actuación en el caso de una PC en un adulto, la calidad de las compresiones torácicas y el uso del DEA. Este proyecto y los resultados preliminares fueron presentados a la comunidad científica durante el ERC Congress en 2017 mediante una comunicación oral (140). Recientemente, los resultados obtenidos de toda la muestra han sido publicados en Resuscitation Journal (115).

En estos programas de entrenamiento, tras la formación y el test práctico, solicitamos a nuestros participantes que rellenaran una encuesta sobre la

dificultad percibida en el uso del desfibrilador y propuestas para mejorar el diseño de los desfibriladores actuales.

Tras evaluar las respuestas obtenidas, durante este último año hemos diseñado y desarrollado una plantilla adhesiva para crear desfibriladores adaptados a personas con discapacidad visual.

La plantilla es negra y cubre sólo la mitad de la cara frontal del desfibrilador. Tiene dos elementos principales: números del 1 al 3 y cuatro palabras [on/off; esperar; pulsar]. Las palabras están en español y también en lenguaje de signos. Todos los elementos de la plantilla tienen relieve, por lo que se pueden percibir por medio del tacto.

Este prototipo se presentó en el último ERC Congress, que tuvo lugar en septiembre de 2018 en Bolonia (Italia) (50).

Nuestro siguiente paso es utilizar este dispositivo adaptado en la formación de grupos con discapacidad visual y comparar su uso con el de los desfibriladores no adaptados.

RESUMO

Formación en Soporte Vital Básico en Centros Escolares.

INTRODUCCIÓN

O paro cardiaco (PC) é a interrupción repentina, inesperada e potencialmente reversible da circulación e a respiración espontáneas. O PC extrahospitalario (PCEH) é a terceira causa de morte nos países industrializados e máis do 70 % son presenciados por testemuñas.

A pesar de que a asistencia precoz por parte das testemuñas pode mellorar a supervivencia e reducir as secuelas, as cifras de reanimación cardiopulmonar (RCP) iniciada por testemuñas atópanse por baixo do 20% na maioría dos países.

No momento en que se produce o colapso, os ritmos desfibrilables están presentes no 50-70% dos PC en adultos. Nestes casos o tratamento idóneo é a desfibrilación precoz, que cuadruplica as posibilidades de supervivencia cando é aplicada nos primeiros 3-5 minutos tras o inicio do PC.

O desfibrilador externo semiautomático (DEA ou DESA) é un dipositivo sinxelo e seguro capaz de analizar o ritmo cardiaco e proporcionar unha descarga eléctrica en caso indicado. A comunidade científica recomenda a formación da poboación no manexo do DEA e a instalación destes dispositivos en lugares públicos como aeroportos ou estadios deportivos.

O deseño simple do DEA permite que poida ser utilizado correctamente por persoas sin formación previa, independentemente da súa idade, nivel de estudos ou diversidade funcional.

Os nenos en idade escolar son unha poboación diana para o adestramento en soporte vital básico (SVB), a súa formación debería garantir un número importante de primeiros intervintes no futuro. Os centros escolares foron sinalados como o entorno axeitado onde comezar a formación en SVB, de feito, o adestramento en colexios presenta o maior impacto no incremento da tasa de intervención por parte das testemuñas. Aínda que non está claro que profesional é o máis axeitado para impartir esta formación, o papel dos mestres foi sinalado como un elemento clave e apoiado por iniciativas internacionais como Kid Saves Lives (“os nenos salvan vidas”) (KSL) e locais como o proxecto ANXOS (Adestrando Nenos e Xóvenes a Salvar vidas).

HIPÓTESES

- O DEA é un dispositivo coñecido polos estudantes de educación primaria e secundaria con idades comprendidas entre os 6 e os 16 anos.
- Os nenos en idade escolar son capaces de utilizar correctamente o DEA seguindo unicamente a súa intuición, sen recibir información ou indicacións previas.
- Un vídeo formativo breve é útil para que escolares aprendan a utilizar correctamente un DEA e para a retención das habilidades aprendidas ao cabo dun mes.
- Os mozos/as con síndrome de Down son capaces de aprender como se utiliza o DEA despois dunha sesión formativa teórica e práctica breve acompañada da visualización dun vídeo formativo.
- Os estudantes universitarios de Ciencias da Educación e do Deporte teñen un coñecemento deficiente en soporte vital básico.
- Os futuros mestres de Educación Primaria e Secundaria están dispostos a formar aos seus alumnos en soporte vital básico.
- Unha sesión formativa breve en soporte vital básico acompañada de correccións a tempo real é útil para mellorar as habilidades en RCP e os coñecementos dos estudantes universitarios en Ciencias da Educación e do Deporte.

OBXECTIVOS:

Os obxectivos principais desta investigación son os seguintes:

1. Analizar a habilidade dos estudantes de educación primaria e secundaria para utilizar un DEA en menos de 3 minutos e de maneira intuitiva, tras a visualización dun vídeo formativo, de inmediato e un mes despois da formación.
2. Avaliar a utilidade dos adestramentos moi breves en SVB para mellorar os coñecementos e habilidades en RCP e desfibrilación dos estudantes universitarios de Ciencias da Educación.

Os obxectivos secundarios son:

1. Investigar se o DEA é un dispositivo coñecido polos estudantes de educación primaria e secundaria con idades comprendidas entre os 6 e os 16 anos.

2. Avaliar o uso intuitivo do DEA por parte de estudantes de educación primaria e secundaria.
3. Analizar se a variable idade está relacionada co mellor uso do DEA nos escolares e comparar os coñecementos e habilidades en desfibrilación segundo a súa etapa educativa.
4. Determinar se un video formativo simple é suficiente para que os escolares aprendan a utilizar un DEA en menos de 3 minutos e reteñan as habilidades aprendidas ao cabo dun mes.
5. Investigar se os mozos/as con síndrome de Down son capaces de aprender a utilizar correctamente un DEA despóis dunha sesión formativa breve teórica e práctica.
6. Avaliar os coñecementos en soporte vital básico dos futuros mestres de Educación Física.
7. Determinar o efecto que produce un adestramento moi breve en soporte vital básico acompañado de correccións a tempo real sobre a aprendizaxe de estudantes universitarios.

RESULTADOS:

Esta tese se presenta baixo a modalidade de compendio de publicación, por este motivo os resultados se presentan como artigos de investigación. Ditos artigos son os seguintes:

1. Habilidades en desfibrilación dos nenos en idade escolar sen formación previa. (*Automated external defibrillation skills by naive schoolchildren*).

O obxectivo deste estudo foi avaliar o uso do DEA por parte de escolares sen recibir formación previa ou indicación durante a práctica.

Realizouse un estudo multicéntrico no que participaron 1295 estudantes con idades comprendidas entre os 6 e os 16 anos sen formación previa en SVB. Os participantes realizaron unha simulación con DEA de adestramento e manequín. A proba foi avaliada mediante unha lista de comprobación específica.

Un total de 258 (19,9 %) participantes usaron o DEA correctamente en menos de 3 minutos. Obtívose unha relación significativa entre a desfibrilación correcta e o grupo de idade. A partir dos 9 anos case un de cada catro participantes conseguiu o obxectivo de descarga efectiva.

O tempo medio foi de 83.3 ± 24.6 segundos e este reduciuse conforme aumentaba a idade do participante [6 anos (108.3 ± 40.4) vs. 16 anos (64.7 ± 18.6)] (p< 0.001).

2. Aprendizaxe do uso do desfibrilador semiautomático mediante métodos audiovisuais en nenos en idade escolar. (*Aprendizaje del uso del desfibrilador semiautomático mediante métodos audiovisuales en escolares*).

O obxectivo deste estudo foi avaliar a habilidade dos escolares para utilizar un DEA correctamente e a retención do aprendizaxe un mes despois da formación.

Realizouse un estudo quasi-experimental con 205 estudantes sen formación previa con idades comprendidas entre os 6 e os 16 anos. Se utilizou DEA de adestramento e manequíns. Os estudantes foron avaliados nunha proba inicial de habilidade (T0), despois foron distribuídos aleatoriamente a un grupo experimental ou control (T1). O grupo experimental visualizou un vídeo formativo e inmediatamente despois realizou a proba de habilidade. O grupo control realizou a proba sen recibir formación previa. Un mes despois ambos grupos foron avaliados por última vez (T2).

A mostra final contou con 196 participantes, todos eles foron capaces de simular unha descarga efectiva en menos de 2 minutos. Os coñecementos sobre o DEA foron mellores nos estudantes de educación secundaria en comparación cos estudantes de primaria (p< 0,001). Non se atoparon diferencias significativas entre os diferentes grupos en T0.

En T1, o número de participantes do grupo experimental que acadou o obxectivo de descarga efectiva foi o dobre que os participantes do grupo control na etapa de primaria [Control: 14(29.8 %) vs. Experimental: 30 (62.5 %), p<0.001]. En canto o obxectivo de calidade, os grupos experimentais acadaron mellores resultados tanto en primaria [Control: 1 (7.1 %) vs. Experimental: 13 (43.3 %), p=0.018] como en secundaria [Control: 3 (13.6 %) vs. Experimental 12 (46.2 %), p=0.017].

En T2, todos os participantes de secundaria melloraron no obxectivo de descarga efectiva, pero o grupo control obtivo peores resultados no obxectivo de calidade.

O tempo acadado foi menor nos estudantes de secundaria e reduciuse en cada unha das etapas do estudo.

3. Profesores como candidatos para o ensino do soporte vital básico: un estudo de simulación. (*Schoolteachers as candidates to be basic life support trainers: A simulation trial*).

O obxectivo deste estudo foi avaliar o coñecemento en SVB dos futuros mestres de Educación Primaria e Secundaria, a súa disposición para impartir estes contidos e valorar o efecto dunha sesión de adestramento breve e práctico apoiado por indicacións a tempo real.

Participaron 98 estudantes universitarios de Ciencias da Educación e do Deporte. O adestramento consistiu nunha breve sesión teórica e práctica cunha relación instrutor participantes 2/10. Avaliáronse os coñecementos antes e despois da formación mediante unha enquisa. Rexistráronse as compresións torácicas e ventilación de 47 participantes nun test práctico de RCP dun minuto de duración.

O coñecemento sobre os estándares de calidade da RCP foi deficiente inicialmente, pero mellorou despois da formación en todos os conceptos avaliados, así como a disposición para utilizar un DEA en caso necesario e a consideración da formación en SVB como moi importante durante a etapa universitaria.

Durante a proba práctica, máis do 80 % das compresións foron realizadas a un ritmo adecuado e con posición de mans correcta. A re-expansión do tórax foi mellor en mulleres (Mulleres: 72.2 + 32.8 % vs. Hombres: 45.4 $\pm$ 32.9 %, p=0.009) mentres que os homes comprimiron con maior profundidade (Hombres: 56.1 $\pm$ 4.03 mm vs. Mulleres: 52.17 $\pm$ 5.51 mm, p=0.007).

4. Adestramento breve no uso do desfibrilador externo semiautomático en persoas con Síndrome de Down. (*Brief training in automated external defibrillation use for persons with down syndrome*).

O obxectivo do estudo foi avaliar as habilidades de desfibrilación en mozos/as con síndrome de Down despois dun programa formativo breve e sinxelo.

No estudo participaron membros e traballadores da Fundación Down Compostela.

Realizamos unha formación breve que consistiu nunha explicación teórica de 5 minutos, visualización dun video breve e cómico e 20 minutos de adestramento práctico. Tras a formación avaliouse individualmente a cada participante.

Participaron 12 terapeutas ocupacionais (TO) e 27 mozos e mozas con síndrome de Down (SD). Todos os TO e 17/22 (63 %) SD acadaron o obxectivo de descarga efectiva (p=0,014). O obxectivo de calidade foi acadado por 11(91,6 %) TO e 8 (57 %) SD. O tempo ata a desfibrilación foi de 50,3 $\pm$ 8 segundos no grupo de OT e 74,5 $\pm$ 15 segundos no grupo SD (p < 0,001).

DISCUSIÓN.

Os escolares foron sinalados como poboación diana esencial para a formación en SVB e o incremento da tasa de inicio da reanimación por testemuñas. Sen embargo, estes nenos non foron estudados profundamente e existen dúbidas sobre diferentes aspectos do seu adestramento: a que idade son capaces de aprender a utilizar un DEA, con que coñecemento inicial contan e que profesionais deberían impartir esta formación.

A presente investigación foi a primeira en abordar a cuestión sobre o coñecemento dos escolares sobre este dispositivo. Os nosos resultados mostran que 3 de cada 4 escolares afirman saber que é un DEA, a pesar de non ter recibido formación previa.

O estudo "Automated external defibrillation skills by naive schoolchildren", o primeiro en avaliar o uso intuitivo do DEA nunha gran mostra (1295 escolares) cun rango de idade amplo (de 6 a 16 anos) mostrou que, a partir dos 9 anos, un de cada catro escolares é quen de utilizar un DEA de maneira intuitiva e, aos 16 anos, a metade dos estudantes, de completar o procedemento con calidade.

Estudos previos, realizados noutros países e con mostras de menor tamaño, obtiveron resultados similares e apoian a capacidade dos nenos de máis de 9 anos de idade para o manexo do DEA de maneira intuitiva e a necesidade de actividades formativas para mellorar os coñecementos e as habilidades.

Na avaliación do tempo, observamos que en todos os casos foi inferior a 3 minutos, e a partir dos 8 anos todos os participantes remataron a proba en menos de 2 minutos. Inmediatamente despois da visualización dun vídeo formativo, o tempo para realizar a descarga redúcese en menos de 70 segundos tanto no grupo experimental como no grupo control e en menos de 55 segundos, un mes despois da formación. Na avaliación da poboación con Síndrome de Down, observamos que tras un adestramento sinxelo e breve o 63% acada unha desfibrilación efectiva nun tempo medio de 75

segundos. Polo que, o tempo para a desfibrilación, diminúe despois dun adestramento breve pero tamén co uso repetido do dispositivo.

A pesar de que os centros escolares son sinalados como o entorno idóneo para a formación en SVB, existen dúbidas sobre que profesional debe ocuparse de impartir estes contidos. A necesidade de persoal sanitario pode supor unha barreira para a implantación do adestramento nas escolas. Estudos previos mostraron que a formación en SVB impartida por mestres previamente adestrados obtén resultados iguais ou mellores que a impartida por adestradores profesionais. Nesta investigación, amósase como un adestramento breve ten un efecto positivo sobre a adquisición de coñecementos e a disposición para impartir estes contidos de estudantes universitarios de Ciencias da Educación e do Deporte.

Nos países onde a formación en RCP forma parte da programación escolar, a RCP iniciada por testemuñas realízase en máis do 40% das PCEH e se asocia a unha supervivencia do dobre ou triplo.

A pronta formación en SVB é avalada por iniciativas internacionais como KSL, que recomenda 2 horas de adestramento en RCP ao ano a partir dos 12 anos de idade. O inicio da formación a unha pronta idade contribúe á familiarización dos escolares e, consecuentemente, a que non esquezan como salvar unha vida. A mellora da supervivencia tras unha PCEH supón unha inversión na saúde pública do futuro.

CONCLUSIÓNS.

1. O DEA é un dispositivo coñecido por unha porcentaxe significativa da poboación escolar.
2. Na actualidade, arredor do 20% dos escolares sen formación previa poden aplicar un DEA en menos de 3 minutos seguindo as indicación acústicas e visuais. Sen embargo, o seu coñecemento non é suficiente para realizar a proba de foram totalmente correcta.
3. As habilidades para a desfibrilación melloran coa idade. Os estudantes de secundaria teñen un mellor desempeño no uso do DEA e o aplican en menos tempo que os estudantes de primaria.
4. A visualización dun vídeo formativo simple e breve é útil para que os escolares melloren o uso do DEA e contribúe á retención das habilidades a curto prazo.

5. Tras un adestramento sinxelo e breve, a maioría dos mozos e mozas con síndrome de Down son capaces de utilizar un DEA en menos de dous minutos, aínda que non acadan o mesmo nivel de rendemento que outros cidadáns.
6. Unha breve formación práctica apoiada por un sistema de retroalimentación a tempo real axuda a mellorar o coñecemento e a autoconfianza en SVB e RCP básica dos futuros mestres.

ABSTRACT

Basic Life Support Training in School Centres.

INTRODUCTION

Cardiac arrest (CA) is the sudden, unexpected and potentially reversible interruption of spontaneous circulation and breathing. Out of hospital CA (OHCA) is the third cause of death in industrialized countries and more than 70% are witnessed. Although bystander assistance could improve survival and outcomes, bystander resuscitation rate is far below 20% in most countries.

At the time of collapse, shockable rhythms are present in 50-70% of CA in adults. In such cases the restoration to a perfusing cardiac activity may be achieved by means of electrical defibrillation, resulting in four-fold higher survival rates when the shock is applied within the first 3-5 minutes.

The automated external defibrillator (AED) is a simple and secure device able to analyse cardiac rhythm, to recognize an arrythmia and to deliver a shock in order to restore a viable cardiac rhythm if required. There are recommendations from the international scientific community that endorsed the training of non-medical staff in the use of AED as well as the implementation of these devices in public places where crowds of people occur, such as airports or sports centres

The simplicity and reliability make the defibrillator a device that can be used by anyone, regardless of age, education degree or handicaps and disabilities.

Children are considered an interesting target group to train in BLS. Their training should provide the guarantee to secure a large number of future rescuers for the community. As well, schools have been pointed out as a perfect environment to start BLS training. In fact, school training has the highest impact for improving the bystander CPR rate. Even though it is not clear which professionals are more suitable for teaching schoolchildren, the inclusion of schoolteachers as a key element of BLS training has been endorsed by international initiatives like Kids Save Lives (KSL) and nationals ones as ANXOS.

HYPOTHESIS:

- The AED is a known device for primary and secondary students aged between 6-16 years old.
- Schoolchildren are able to use the AED correctly following their intuition, without any prior training or indications.
- A brief formative video is enough for schoolchildren learn how to use an AED and for one-month skill retention.
- Young persons with Down syndrome are able to learn how to use an AED after a very brief theoretical and hands-on training supported by a brief formative video.
- University Educational Science students BLS knowledge is deficient currently.
- Future school teachers have willingness to include BLS topics in their scholar lessons.
- A brief BLS training session supported by real-time feedback is useful for university Educational Science students improve their CPR skills and knowledge.

OBJECTIVES:

The main objectives of this research are:

1. To analyse the ability of primary and secondary schoolchildren to use an AED correctly in less than 3 minutes intuitively, after viewing a short instructional video and one-month after instruction.
2. To assess the usefulness of very brief BLS training programs to improve CPR-AED knowledge and skills of university educational science students.

The secondary objectives of the present research are:

1. To investigate if the AED is a known device for primary and secondary schoolchildren aged between 6-16 years old.
2. To assess primary and secondary schoolchildren AED use following only their intuition, without any prior training.
3. To ascertain if the variable age is related with better AED use in schoolchildren and to compare defibrillation knowledge and skills according to educational stage.

4. To determine if a simple formative video is enough for schoolchildren learn to use an AED in less than 3 minutes and retain this skill after one month.
5. To investigate if Down syndrome young people are able to learn how to use and AED after a brief theoretical and hands-on training.
6. To assess future Physical Activity teachers current BLS knowledge and skills.
7. To determine the learning effect of a brief BLS training session supported by real-time quality feedback in university students.

RESULTS:

This thesis follows an article compendium modality. Therefore, the results are presented as research articles.

1. Automated external defibrillation skills by naïve schoolchildren.

The objective of this study was to assess the current ability of schoolchildren to use an AED without any prior training or feedback during the performance.

A multicentre descriptive study was carried out, 1295 children from 6 to 16 years of age without previous BLS or AED training took part in this study. Subjects performed a simulation with an AED and a manikin with no training or feedback and were evaluated by means of a checklist.

A total of 258/1295 (19.9%) participants managed to simulate an effective and safe discharge in less than 3 minutes time.

Gamma coefficient showed a mild but significant correlation between correct defibrillation and age group ($G = 0.172$) ($p < 0.001$).

From 9 years old on, almost one out of four managed to achieve the defibrillation objective.

Time Global average was 83.3 ± 24.6 s. Time to defibrillation decreased with increasing age [6 years old (108.3 ± 40.4) vs. 16 years old ($64.7 + 18.6$)] [$p < 0.001$].

2. Learning how to use the semiautomatic defibrillator by means of audiovisual methods in schoolchildren. (*Aprendizaje del uso del desfibrilador semiautomático mediante métodos audiovisuales en escolares*).

The aim was to assess the ability of schoolchildren to use an AED to provide an effective shock and their retention of the skill 1 month alter training exercise supported by audio-visual materials.

Quasi-experimental controlled study in 205 initially untrained schoolchildren aged 6 to 16 years old was conducted. AEDs were used to apply shocks to manikin. The students took a baseline test (T0) of skill and were then randomized to an experimental or control group in the first phase (T1). The experimental group watched a training video and both groups were then retested. The children were tested in simulation again 1 month later (T2).

The whole sample (196) was able to use the AED correctly in less than 2 minutes time.

AED knowledge was better in secondary students ($p<0.001$). No significant differences were obtained between groups in the basal test

After training, the number of those experimental group participants who accomplished defibrillation objective was double than control group in primary stage [Control: 14(29.8%) vs. Experimental: 30 (62.5%), $p<0.001$]. Regarding quality objective, experimental group reached better results in primary stage [Control: 1 (7.1%) vs. Experimental: 13 (43.3%), $p=0.018$] also in secondary stage [Control: 3 (13.6%) vs. Experimental 12 (46.2%), $p=0.017$].

In T2, all secondary students improved the defibrillation objective but control group achieved worse results for quality objective

Concerning time analysis, this variable was shorter in secondary group and was decreasing in each study step.

3. Schoolteachers as candidates to be basic life support trainers: A simulation trial.

The aim was to assess future schoolteacher´s BLS knowledge and willingness to include this content in school lessons and also to determine the learning effect of a brief BLS hands-on training session, supported by real-time feedback.

A convenience sample of 98 University students of Educational Sciences and Sports were recruited. The training program consisted of a brief theoretical and hands-on interactive session with 2/10 instructor/participants ratio. Knowledge and willingness were assessed by means of a survey. Chest compressions and ventilation quality were registered in 47 cases during 1-minute CPR tests.

CPR quality standards knowledge was poor firstly but, after training, knowledge improved in all concepts as well as the willingness to use an AED in an eventual emergency situation and the consideration of university BLS training as very important.

During one-minute test, more than 80% of chest compressions (CC) were performed at an adequate rate and all were delivered with correct hand position. Full chest recoil was better in women (Women: 72.2 + 32.8% vs. Men: 45.4 + 32.9%, p=0.009) and men group performed deeper CC (Men: 56.1 + 4.03 mm vs. Women: 52.17 + 5.51 mm, p=0.007).

4. Brief training in automated external defibrillation use for persons with Down syndrome.

The objective was to asses AED skills in young people with Down syndrome after a very brief and simple training program.

We invited member and staff of the Down Compostela Foundation to participate in a brief training program consisted on: 5 minutes easy lecture, short funny video watching and 20 minutes hands-on training. After training, every participant was tested individually in a simulated scenario, performance was evaluated by means of a check list.

All OT people and 17/22 (63%) DS participants accomplished the defibrillation objective [p = 0,014]. Quality objective was obtained by 11 (91,6%) OT people and 8 (47%) DS participants (p = 0,013). Time to defibrillation was 50,3 $\pm$ 8 seconds in the OT group and 74,5 $\pm$ 15 seconds in the DS group (p < 0,001).

DISCUSSION

Schoolchildren have been pointed out as an essential target group for BLS training. However, this sample have not been studied in a widespread way and it is not clear at what age schoolchildren are capable of learning different aspects of first-aid like AEDs use and how is their background knowledge on the subject or which professional is more suitable to lead this training.

The present research was the first to present the topic of schoolchildren AED knowledge. Our results shown that 3 of every 4 schoolchildren stated to know what an AED is, despite any of them had been trained in AED previously.

The study "Automated external defibrillation skills by naive schoolchildren" the first to assess the intuitive AED use in a large sample (1295 untrained schoolchildren) with a wide age range (from 6 to 16 years of age), showed that from the age of 9, one of every 4 schoolchildren are capable of applying the AED intuitively, and at the age of 16 half of the capable students are able to complete the procedure with quality.

Prior studies, conducted in other countries with smaller samples, obtained similar results which endorsed that from 9 years old schoolchildren are able to use an AED intuitively and the need of training programs in order to improve knowledge and skills.

Regarding time, this was less than 3 minutes in all cases and, from the age of 8 years old all participants completed the practical test in less than 2 minutes. Immediately after view a formative video, time to defibrillation decreased up to 70 seconds and one month after instruction was less than 55 seconds. Concerning Down Syndrome participants, after a brief and simple training 63% of them accomplished a defibrillation goal in a mean time of 75 seconds. Thus, time to defibrillation decrease after training and also with repeated use.

Instead of that schools have been pointed out as perfect environment to start BLS training it is no clear which professional is more suitable to lead this training. The need of healthcare professional could mean a barrier for BLS school training. Prior studies have shown that BLS training provided by schoolteachers is as effective or even more than training provided professional instructors. Current research shows how a very brief and simple training program have positive effect for knowledge and willingness to provided this content in university student of educational science and sports.

In countries where CPR is a mandatory part of school curriculum, bystander CPR is performed in more than 40% of OHCA and has been associated with double to triple survival rates.

Early BLS training is endorsed by international initiatives like KSL, which propose 2 hours per year of CPR training from the age of 12. Starting at a young age, children will not forget how to save a life and survival rate of people with OHCA could improve by the factor of two fourfold. This endorsed the idea that training schoolchildren is a good investment for the future

CONCLUSIONS

1. The AED is a device known by a significant percentage of the school population and the school stage is significantly related to AED knowledge, which is better in secondary students.
2. Currently around 20% of theoretically naïve schoolchildren are able to apply an AED in less than 3 minutes by means of their general knowledge and device´s acoustic and visual instructions. However, children´s background knowledge and AED instructions alone are not enough to perform the procedure satisfactory.
3. Defibrillation skills improve with age. Secondary students perform better AED use and they apply the shock in a shorter time than primary schoolchildren.
4. The visualization of a simple and brief formative video is useful for schoolchildren improve AED use and contributes to short-term retention of learnt skills.
5. After a simple and brief training, most of Down syndrome young people are able to use an AED device in less than two minutes, although they don't achieve the same level of performance of other citizens.
6. Brief hands-on training supported by real-time quality feedback helps to improve knowledge and self-confidence in BLS and CPR skills of future schoolteachers. BLS training should be implemented in the University curricula for schoolteacher to promote the engagement of these professionals in effective BLS training of schoolchildren as supported by initiatives such as Kids Save Lives

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1. INTRODUCTION

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1. INTRODUCTION

Cardiac arrest (CA) is the sudden, unexpected and potentially reversible interruption of spontaneous circulation and breathing (1).

In 1981 Peter Safar, a pioneer in critical care medicine and known as the father of cardiopulmonary resuscitation (CPR) (2), defined "*sudden cardiac death*" as an "*unexpected cardiac arrest without pre-arrest symptoms or with symptoms of <1-hour duration*" (3). For many individuals, sudden cardiac death is the first manifestation of cardiovascular disease (4,5).

As the last registries have shown (6, 7), diseases of the heart and circulatory system are the leading cause of mortality in Europe, responsible of 45% of all deaths. The main forms of cardiovascular disease are ischaemic heart disease and stroke, which are respectively the first and the second most common single cause of deaths in Europe. Regarding premature mortality, ischaemic hearth disease is the leading single cause of death under 65 years old in both men (16%) and women (11%) (6,7).

CA affects about 350,000 - 700,000 individuals per year (8) and European registries have shown that around 275,000 happening outside of the hospital (9). Currently, sudden out-of-hospital cardiac arrest (OHCA) is the third leading cause of death in industrialized nations (10). Up to 70% of OHCA are witnessed (11, 12, 13); but although bystander assistance could improve survival and outcomes, bystander resuscitation rate is far below 20% in most countries (14,15,16,17)

Owing to the massive number of cases involved and the social and economic impact, sudden death due to CA represent one of the greatest challenges facing modern medicine (17).

The chain of survival (Image 1) was first published in 2005 European Resuscitation Council (ERC) Guidelines (18,19). The chain of survival concept supports that survival from CA depends on a sequence of interventions and emphasises that all steps must be optimised to maximise the chance of achieving neurologically intact survival (19, 20, 21).

The aim of the first link, early recognition and call for help, is to activate the emergency medical system (EMS) in the hope that early treatment could improve survival and outcomes. The majority of patient with a CA have symptoms for a significant duration before the event, thus, to improve the understanding of sudden CA circumstances could be helpful in developing proper reactions to such an expected event (22).

The second and the third steps [early basic life support (BLS) and early defibrillation] depict the fundamental components of early resuscitation in an attempt to reduce cerebral and coronary hypoxia and to restore life.

The last intervention, advanced life support, is targeted at preserving function, essentially brain and heart. This last step recognises the importance of restoring quality of life to the CA survivor (19)

The contribution of the four interventions to improve survival rates diminishes rapidly as patients succumb at each stage of chain (21). In other words, a small minority of patients who enter the initial link in the chain of survival actually progressing through to the final link (21, 23, 24).

Thus, in May 2018, the ERC has proposed an alternative graphical representation of chain of survival which shows a different size links (Image 2). It is not intended that this alternative replace the "classic" chain of survival, which is still the most recommended for laypeople education. The aim of new depiction is to inform scientific community where there is greatest potential to improve survival (21).

Currently, database studies in Europe (9) and North America (25) are reporting shockable initial rhythms in approximately 25% of CA when EMS arrive at victim location. Thus, if population is not well trained in CA recognizing, call for help, start chest compressions and request a defibrillator, defibrillation may not be useful (8).

Image 1 : The chain of survival. (8,18,19).
Reprinted from Resuscitation Journal, 95, Perkins G, Handley A, Koster R, Castrén M, Smyth MA, Olasveengen T, et al. European Resuscitation Council Guidelines for Resuscitation 2015: Section 2. Adult basic life support and automated external defibrillation. Pages 81-99. Copyright (2015) with permission from Elsevier.

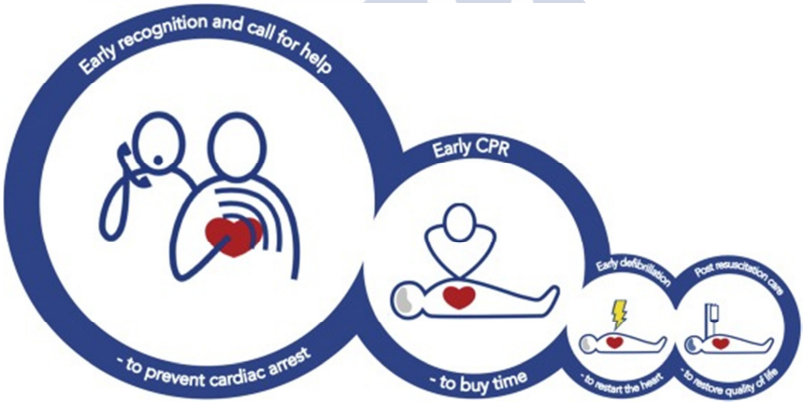

Image 2: New graphical representation of chain of survival for OHCA (Area ratios 1.0, 0.47, 0.12, 0.12) (21).
Reprinted from Resuscitation Journal, 126, Deakin C. The chain of survival: Not all links are equal. Pages 80-2. Copyright (2018) with permission from Elsevier.

At the time of collapse, shockable rhythms are present in 50-70% of CA in adults. In such cases the restoration to a perfusing cardiac activity may be achieved by means of electrical defibrillation, resulting in four-fold

higher survival rates when the shock is applied within the first 3-5 minutes (8, 26, 27, 28).

The importance of early defibrillation in the management of ventricular fibrillation (VF) was demonstrated in a study of in-hospital CA in which patients that received prompt defibrillation had a survival to discharge rate of 39 %. In contrast, patients of whom defibrillation was delayed by 2 min or more from the onset of VF had a survival to discharge rate of 22 % (29). These results agree with those obtained in a Swedish study of OHCA in which patients with VF undergoing defibrillation with minimal delay had a survival rate at 1 month of approximately 50 % while those with a delay of 15 min had a survival rate of only 5 % (30).

The automated external defibrillator (AED) is a simple and secure device able to analyse cardiac rhythm, to recognize an arrythmia and to deliver a shock in order to restore a viable cardiac rhythm if required (31). Defibrillation within 3–5 min of collapse can produce survival rates as high as 50–70% (8, 32, 33). Early defibrillation can be achieved through CPR providers using public access and on-site AEDs. There are recommendations from the international scientific community, led by the ERC and the American Heart Association (AHA), that endorsed the training of non-medical staff in the use of AED as well as the implementation of these devices in public places where crowds of people occur, such as airports, sports centres, schools, public transports, stations and shows (8, 34, 35).

The association between early defibrillation and increased survival after CA was observed in a study conducted in Japan from 2005 through 2013. In this study an increased use of public-access defibrillation by bystanders was associated with increased 1-month survival with favourable neurologic outcome after OHCA with ventricular fibrillation rhythm (36). These results are concordant with those showed in other studies (37, 38, 39) like Hansen et al. who carried out a study in North Carolina between 2010 and 2013 (40) and found an association between nationwide formative initiatives and an increase bystander first response.

Thus, bystander resuscitation is crucial for survival of OHCA (41-46). The survival rates are two to four times higher when bystander CPR is provided (41,47) and several studies have shown that early defibrillation in cases of OHCA with ventricular fibrillation is the single most important determinant of outcomes (26,27,28).

Statewide educational interventions could improve the medium- and long-term survival and livelihood of patients after CA and this supposes a good investment for the future public health.

The simplicity and reliability make the defibrillator a device that can be used by anyone, regardless of age, education degree or handicaps and disabilities. Prior studies have shown that young people with Down syndrome are able to learn how to use an AED and perform an effective shock in a simulated scenario between the first 3-5 minutes since CA identification, a time compatible with the concept of "early defibrillation" (8, 48,49). Likewise, it has been demonstrated that a visual impairment is not an obstacle for correct AED use after a brief training (50).

Most of child and young handicapped people experience participation restrictions in daily activities and social roles (51). Therefore, AED training could work as an activity that enhances inclusion and promotes the active role in the society of handicapped collectives (48-50).

A successful strategy to improve bystander CPR is to simplify training in order to make it more accessible to the population (52, 53). This strategy has been taken into account by scientific societies, which currently propose simple and reduced algorithms with the aim of improving knowledge acquisition and retention. Although the recommendations are similar, we can find differences between the algorithm proposed by the ERC and the one developed by the AHA (8, 54) (Images 3 and 4). In this way, even though the content is practically the same in both, we observe that the ERC algorithm presents the information in a simpler and more schematic way.

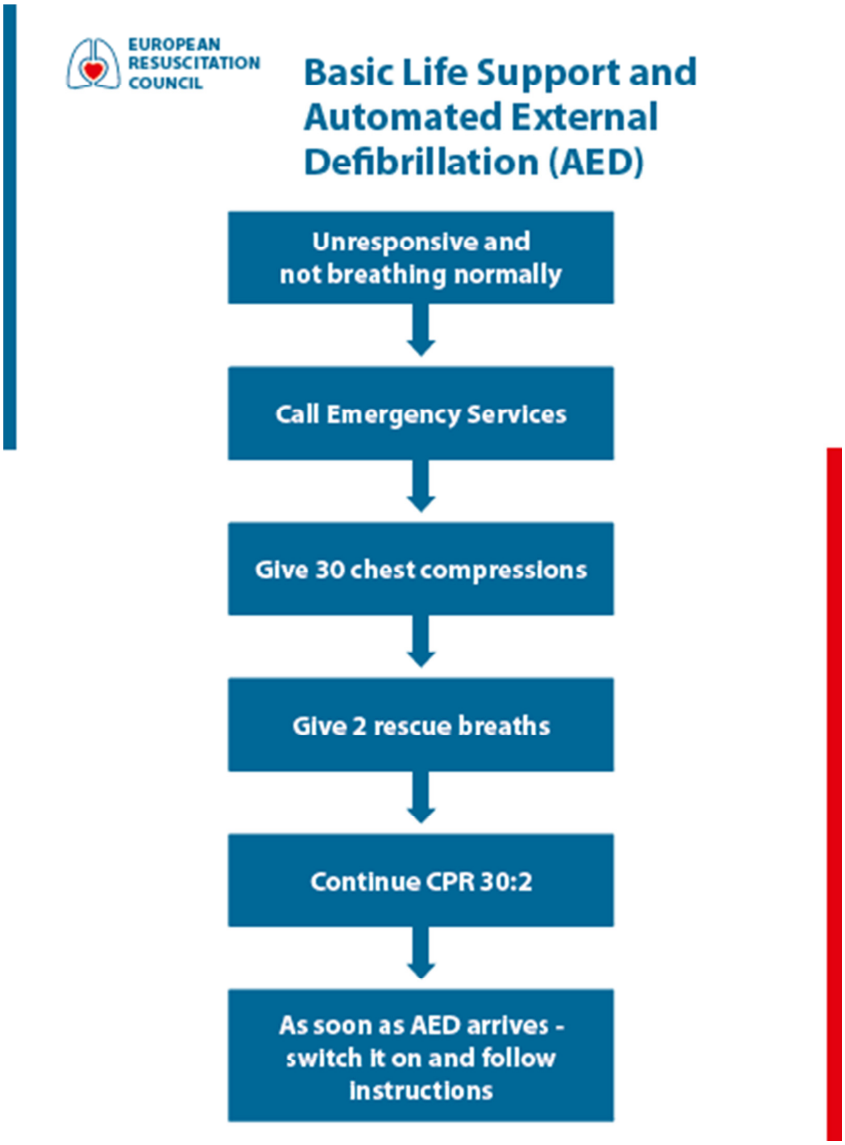

Image 3: Algorithm for adult basic life support and AED use proposed by the ERC included in ERC Guidelines for Resuscitation 2015 (8)

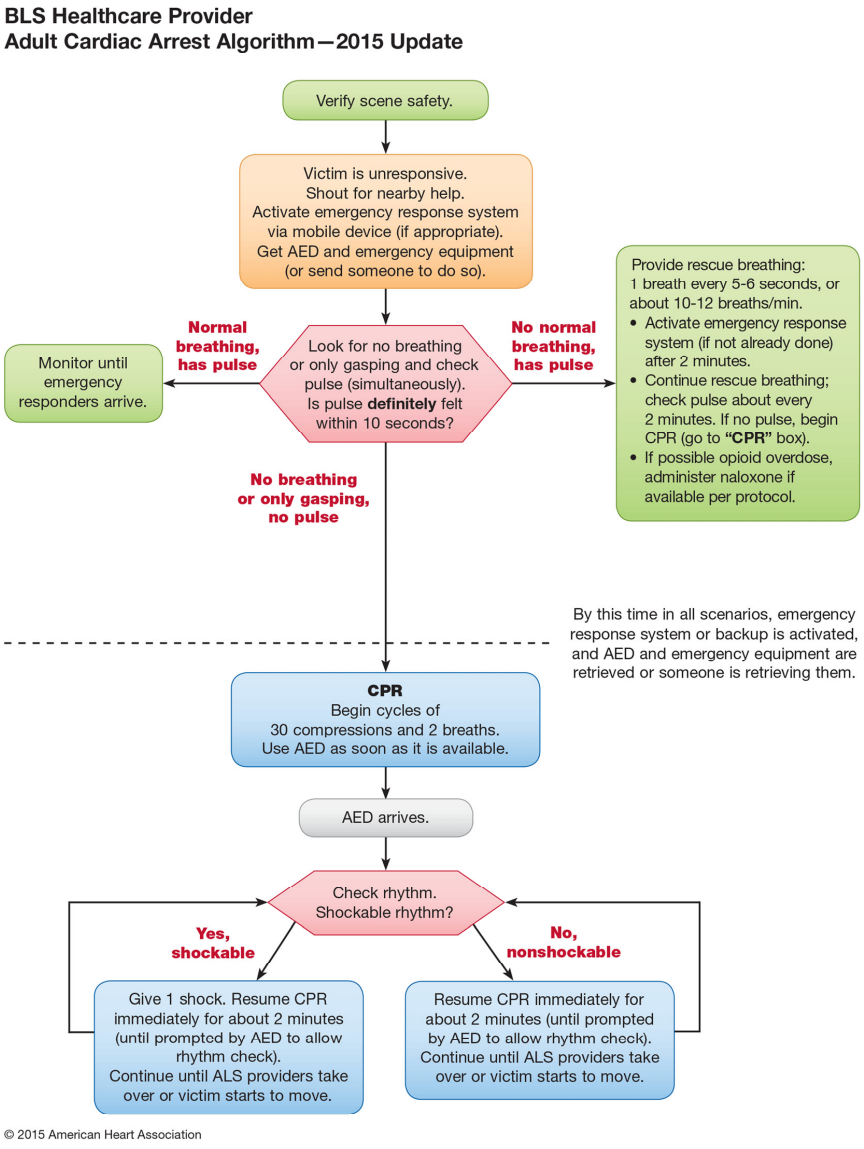

Image 4: Algorithm for adult basic life support and AED use proposed by the AHA included in Guidelines for cardiopulmonary resuscitation and emergency cardiovascular care, 2015 (54). Reprinted from Circulation Journal, 132 (suppl 2). Kleinman M, Brennan E, Goldberger Z, Swor R, Terry M, Bobrow B, et al. Part 5: adult basic life support and cardiopulmonary resuscitation quality: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Pages S414-S435. Copyright (2015) with permission from Elsevier.

Very brief BLS training programs might be enough to improve knowledge and skills of both, adults and schoolchildren (55, 56). This kind of training could ease formation access as well as regular retraining (14,57,58) without significant interference or changes to the regular scholar curriculum. In addition, feedback and self-instructed learning seem to be useful tools to strengthen CPR learning (59, 60, 61, 62, 63, 64, 65).

Many initiatives have been implemented and supported by the international scientific community in order to spread BLS training and to reach the entire population. The "World restart a heart day" (66) and "Kids save lives" (67-76) are examples of these initiatives. Currently, there is a project in our region called Project ANXOS which aims to include BLS training in schools. This project supports the role of the teacher as instructor and highlights the need to adequately train teachers as a starting point for school training (77).

Children are considered an interesting target group to train in BLS, they are also situated in a vital stage of easy learning (75,78); they training should provide the guarantee to secure a large number of future rescuers for the community (75,79). As well as, schools have been pointed out as a perfect environment to start BLS training (75,78-82), in fact, school training has the highest impact for improving the bystander CPR rate (14,41). Even though it is not clear which professionals are more suitable for teaching schoolchildren, the inclusion of schoolteachers as a key element of BLS training has been endorsed by international initiatives like Kids Save Lives (67-76) and local ones as ANXOS (77).

Previous studies have reported that teachers have willingness to provide this instruction and BLS training provided by trained teachers is as effective as the training provided by healthcare professionals (55,56,73,74,83 - 86). If training is led by teachers and no medical staff is needed, barriers that could prevent the implementation of training programmes would be removed.

Training schoolchildren in BLS can form one part of a strategy for increasing bystander resuscitation and it is a successful method for training a large population group (87, 88). Training should start at early ages and it can be widened and adapted to the different school degrees.

The European Map of CPR education in schools, designed by Kids Save Lives Project and published in October 2016, shows the condition of school CPR training in European countries and was based on a survey answered by 27 countries. This Map was updated in October 2018 after poll countries again (Image 5) (67). In this instance, thirty-one of 34 countries invited, completed the survey. The current map shows that education in CPR is a legislation in 5 countries and a suggestion in twenty-three. Spain appears as a country where CPR school training is a suggestion but the truth is that Spain counts on a legislation since 2014 (89) which includes first aid training in primary education, nevertheless the implementation is very deficient (90,91). One of the reasons that interferes with the implementation of CPR training in schools is that there are no well-established programmes to train teachers.

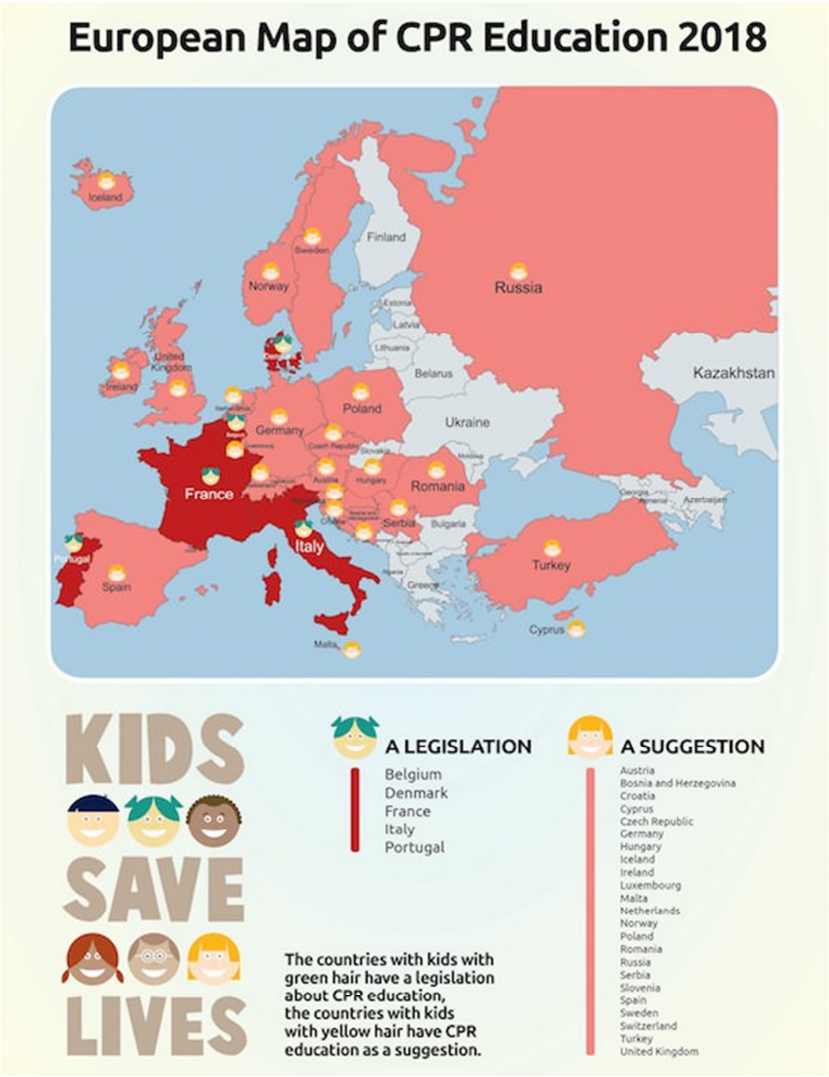

Image 5: Kids Save Lives Campaign. European Map of CPR education in schools. (67). Reprinted from Resuscitation Journal, 131. Semeraro F, Wingen S, Schroeder DC, Ecker H, Scapigliati A, Ristagno G, et al. KIDS SAVE LIVES—Three years of implementation in Europe. Pages e9-11. Copyright (2018) with permission from Elsevier.

2. HYPOTHESIS

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2. HYPOTHESIS

The hypotheses put forward in the different studies were:

- The AED is a known device for primary and secondary students aged between 6-16 years old.
- Schoolchildren are able to use the AED correctly following their intuition, without any prior training or indications.
- A brief formative video is enough for schoolchildren learn how to use an AED and for one-month skill retention.
- Young persons with Down syndrome are able to learn how to use an AED after a very brief theoretical and hands-on training supported by a brief formative video.
- University Educational Science students BLS knowledge is deficient currently.
- Future school teachers have willingness to include BLS topics in their scholar lessons.
- A brief BLS training session supported by real-time feedback is useful for university Educational Science students improve their CPR skills and knowledge.

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3. OBJECTIVES

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3. OBJECTIVES.

3.1 Main Objectives

1. To analyse the ability of primary and secondary schoolchildren to use an AED in less than 3 minutes intuitively, after viewing a short instructional video, immediately and one-month after instruction.

2. To assess the usefulness of very brief BLS training programs to improve CPR-AED knowledge and skills of university Educational Science students.

3.2 Secondary Objectives.

1. To investigate if the AED is a known device for primary and secondary schoolchildren aged between 6-16 years old.

2. To assess primary and secondary schoolchildren AED use following only their intuition, without any prior training.

3. To ascertain if the variable *age* is related with better AED use in schoolchildren and to compare defibrillation knowledge and skills according to educational stage.

4. To determine if a simple formative video is enough for schoolchildren learn to use an AED in less than 3 minutes and retain this skill after one month.

5. To investigate if Down syndrome young people are able to learn how to use and AED after a brief theoretical and hands-on training.

6. To assess future Physical Activity teachers current BLS knowledge and skills.

7. To determine the learning effect of a brief BLS training session supported by real-time quality feedback in university students.

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4. RESULTS

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4. RESULTS.

This thesis follows an article compendium modality. Therefore, the results are presented as research articles.

In this section, the main results of the study performed are presented.

Three articles are presented as results and one letter to the Editor as complementary results. The three first articles compose the central core of the thesis.

Before the presentation of each article, references from the journal and evidence of quality data are summarized. All the articles went through a peer review process and were published throughout the doctoral period.

4.1 Article 1.

Original title:

Automated external defibrillation skills by naïve schoolchildren.

Authors:

Cristina Jorge Soto, Cristian Abelairas Gómez, Roberto Barcala Furelos, Anxela Garrido Viñas, Rubén Navarro Patón, María Muíño Piñeiro, M. Pino Díaz Pereira, Antonio Rodríguez Núñez.

Identification of the article:

Doi: 10.1016/j.resuscitation.2016.06.007

PMID: 27353288

Identification of the journal:

Resuscitation

ISSN: 0300-9572

Impact factor 2017: 5,863

Quartil / Research area: Q1 / Emergency medicine.

Doctoral student contributions

In relation to the present article, the doctoral student took part in the study and timeline design.

She, also, contacted several centres likely to participate in this study and informed in writing of the aim and methodology.

Together with her colleagues, she carried out the selection of the sample, according to the established inclusion and exclusion criteria.

The doctoral student took part in the fieldwork and carried out the coding of the data obtained.

Lastly, she wrote the paper according to Journal´s instructions.

4.1.1 Evidence of Quality.

Citations up to December 2018.

1. Schroeder DC, Ecker H, Wingen S, Semeraro F, Böttiger B. "Kids Save Lives"-resuscitation training for schoolchildren: Systematic review. Anaesthesist. 2017;66(8):589-97. (69)

2. Jorge-Soto C, Abilleira-González M, Otero-Agra M, Barcala-Furelos R, Abelairas-Gómez C, Szarpak L, Rodríguez-Núñez A. Schoolteachers as candidates to be basic life support trainers: A simulation trial. Cardiol J. [Internet]. 2018. [citado el 8 de nov de 2018] Disponible en: https://journals.viamedica.pl/cardiology_journal/article/view/CJ.a2018.0073 (88).

3. Fuchs P, Obermeier J, Kamysek S, Degner M, Nierath H, Jürß H, et al. Safety and applicability of a pre-stage public access ventilator for trained laypersons: a proof of principle study. BMC Emerg Med. 2017;17(1):37. (92).

4. Finke S-R, Schroeder DC, Ecker H, Wingen S, Hinkelbein J, Wetsch WA, et al. Gender aspects in cardiopulmonary resuscitation by schoolchildren: A systematic review. Resuscitation. 2018;125:70-8 (93).

5. Padoan L, Rossi C, Badon P, Oumghar HA, Buchini S. Educazione alle manovre di rianimazione cardiopolmonare nei bambini/ragazzi in età scolare: revisione della letteratura. Scenario. 2018;35(3):18-34. (94).

6. Jorge-Soto C, Fernández-Méndez F, González-González Z, Fandiño-Reissman FG, Otero-Agra M, Barcala-Furelos R, et al. Football referees as first responders in cardiac arrest. Assessment of a Basic Life Support training program. Signa Vitae.2018. 14(2): 41-5. (95).

7. Bálint B. When do we start? - Evaluating the effectiveness of the Early Childhood Education Programme in kindergartens and primary schools. [Internet]. 2018 [citado 27 de nov de 2018]; Disponible en: https://pea.lib.pte.hu/handle/pea/17850 (96).

8. Jiwen W, Pengfei W. First aid capacity and public willingness survey and logistic regression analysis. Jiujiang University Journal: Natural Science Issue. 2016;31(4):66-9. (97).

Journal subjective evidence of quality.

Resuscitation is a monthly international and interdisciplinary medical journal. This journal is the only that is focused entirely on cardiac arrest and cardiopulmonary resuscitation.

Resuscitation is the official journal of the European Resuscitation Council. The ILCOR and ERC consensus on science and treatment recommendations on resuscitation and ERC Resuscitation Guidelines are released through this journal.

4.1.2 Article abstract including main results.

Aim: The objective of this study was to assess the current ability of schoolchildren to use an AED without any prior training or feedback during the performance.

Methods: A multicentre descriptive study, 1295 children from 6 to 16 years of age without previous BLS or AED training. Subjects performed a simulation with an AED and a manikin with no training or feedback and were evaluated by means of a checklist.

Results: A total of 258/1295 (19.9%) participants managed to simulate an effective and safe discharge in less than 3 minutes time.

Gamma coefficient showed a mild but significant correlation between correct defibrillation and age group ($G = 0.172$) ($p < 0.001$).

From 9 years old on, almost one out of four managed to achieve the defibrillation objective.

Fifty-two (20.1%) out of 258 participants who reached the defibrillation objective, achieve the quality objective too. Despite gamma coefficient showed a direct relation between quality objective and age group, no statistical significance was obtained ($G=0.150$) ($p=0.152$).

Regarding errors committed during AED use, the most common was change the execution order [197/258 (76.4%)] followed by pads exchange [37/258 (14.3%)].

Time was analysed among 258 student who accomplished the defibrillation goal. Global average was 83.3 $\pm$ 24.6 seconds. Time to defibrillation decreased with increasing age [6 years old (108.3 $\pm$ 40.4 seconds) vs. 16 years old (64.7 $\pm$ 18.6 seconds)] ($p< 0.001$). In a peer post hoc analysis we found that the average time was significantly shorter for older students than for youngers students ($p< 0.001$ in all contrasts) and also no significant differences were obtained between younger groups (from 6 to 10 years old) neither amongst the older groups (from 12 to 16 years old).

Conclusions: Around 20% of schoolchildren without prior training are able to use an AED correctly in less than 3 minutes following the device´s acoustic and visual instructions. However, only one-fifth of those who showed success managed to complete the procedure satisfactorily.

Limitations: The test was carried out under simulation conditions so results are probably not the same as those that would be obtained in a real situation. The questionnaire did not include how kids had learned about AED [mass media, relatives, etc], authors feel now that this point could add some relevant information to the study.

Automated external defibrillation skills by naïve schoolchildren.

https://www.ncbi.nlm.nih.gov/pubmed/27353288

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4.2 Article 2

Original title:

Aprendizaje del uso del desfibrilador semiautomático mediante métodos audiovisuales en escolares.

Authors:

Cristina Jorge Soto, Cristian Abelairas Gómez, Roberto Barcala Furelos, Carolina Gregorio García, José Antonio Prieto Saborit, Antonio Rodríguez Núñez.

Identification of the article:

PMID: 29105431

Identification of the journal:

Emergencias

ISSN: 1137-6821

Electronic ISSN: 2386-5867

Impact factor 2017: 3,608

Quartil / Research area: Q1 / Emergency medicine.

Doctoral student contributions

Relative to the present article, the doctoral student took part in the study and timeline design.

She informed the school centre in writing of the study aim and methodology.

Together with her colleagues, she carried out the selection of the sample, according to the established inclusion and exclusion criteria.

The doctoral student took part in the fieldwork and carried out the coding of the data obtained.

Lastly, she wrote the paper according to Journal´s instructions. As corresponding author, carried out the corrections and revisions requested by the Journal and sent all the documents required for publication.

4.2.1 Evidence of quality.

Citations up to December 2018:

1. Alvarez-Cebreiro N, Abelairas-Gómez C, García-Crespo O, Varela-Casal C, Rodriguez-Nuñez A. Efecto de la formación en soporte vital básico a través de un video difundido en redes sociales. Educ Médica [Internet]. 2018 [citado 20 de oct de 2018]; Disponible en: http://www.sciencedirect.com/science/article/pii/S1575181318302079 (98)

2. Angulo-Menéndez P, Lana A, Morís de la Tassa J. Conocimientos y disposición para realizar soporte vital básico por agentes de la policía local. An Sist Sanit Navar. 2017;40(2):177-85. (99)

3. Espinosa C, Caballero S, Rodríguez L, Mochón J, Melgarejo F, Martínez C, et al. Ensayo clínico aleatorizado controlado que compara la formación presencial frente a la no presencial en el aprendizaje teórico de la reanimación cardiopulmonar entre los estudiantes de secundaria. Emerg. 2018;30(1):28-34. (100)

4. Fernandez-Mendez F, Saez-Gallego NM, Barcala-Furelos R, Abelairas-Gomez C, Padron-Cabo A, Perez-Ferreiros A, et al. Learning and Treatment of Anaphylaxis by Laypeople: A Simulation Study Using Pupilar Technology. BioMed Res Int [Internet]. 2017 [citado 20 de oct de 2018]. Disponible en: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5516735/ (101).

5. Jorge-Soto C, Fernández-Méndez F, González-González Z, Fandiño-Reissman FG, Otero-Agra M, Barcala-Furelos R, et al. Football referees as first responders in cardiac arrest. Assessment of a Basic Life Support training program. Signa Vitae.2018. 14(2): 41-5 (95).

Journal subjective evidence of quality.

Emergencias is the official Journal of Spanish Emergency Medicine Association (SEMES). This journal publishes 6 issues per year and conducts a double-blind peer review procedure. The main topics deal with emergency care in different forms: emergencies and urgencies, health catastrophes, rescue and emergency health transport, and health coordination and management. SEMES is a scientific society dedicated to

providing service and support to emergency professionals so that they can offer better health care to all those they serve. One of its main objectives is to provide health education to the population with the aim of protecting and improve public health.

4.2.2 Article abstract including main results.

Aim: To assess the ability of schoolchildren to use AED to provide an effective shock and their retention of the skill 1 month alter training exercise supported by audio-visual materials.

Methods: Quasi-experimental controlled study in 205 initially untrained schoolchildren aged 6 to 16 years old. AEDs were used to apply shocks to manikin. The students took a baseline test (T0) of skill and were then randomized to an experimental or control group in the first phase (T1). The experimental group watched a training video and both groups were then retested. The children were tested in simulation again 1 month later (T2).

Results: The whole sample (196) was able to use the AED correctly in less than 2 minutes time.

AED knowledge was better in secondary students, thus 96 (95%) knew what an AED is, compared with 54 (56.8%) primary students ($p<0.001$). On the contrary, twenty (19.8%) secondary students stated to know how to use an AED in contrast with 8 (8.4%) primary students ($p=0.023$). No significant differences were obtained between experimental and control group in the basal test, neither for defibrillation objective nor for quality objective in both, secondary and primary stage.

After training activity (formative video), the number of those experimental group participants who accomplished defibrillation objective was double than control group in primary stage [Control: 14(29.8%) vs. Experimental: 30 (62.5%), $p<0.001$]. Regarding quality objective, experimental group reached better results in primary stage [Control: 1 (7.1%) vs. Experimental: 13 (43.3%), $p=0.018$] also in secondary stage [Control: 3 (13.6%) vs. Experimental 12 (46.2%), $p=0.017$].

Regarding retention test, primary schoolchildren defibrillation objective accomplishment was similar for both groups, but experimental group got worse in quality objective. All secondary students improved the

defibrillation objective but control group achieved worse results for quality objective [Control: 0 vs. Experimental: 9 (28.1%), p=0.001].

Concerning time analysis, this variable was shorter in secondary group and was decreasing in each study step.

Conclusions: Previously untrained secondary students know what an AED is and half of them can manage to use one in simulation. Brief narrative, audio-visual instructions improves student´s skill in manage an AED and helps them retain what they learned for later use.

Limitations: All participants were recruited from the same school centre; thus, some selection bias are possible regarding social, cultural and economic features.

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Aprendizaje del uso del desfibrilador semiautomático mediante métodos audiovisuales en escolares.

https://dialnet.unirioja.es/servlet/articulo?codigo=5389585

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4.3 Article 3

Original title:

Schoolteachers as candidates to be basic life support trainers: A simulation trial.

Authors:

Cristina Jorge-Soto, Maite Abilleira-González, Martín Otero Agra, Roberto Barcala Furelos, Cristian Abelairas Gómez, Lukasz Szarpak, Antonio Rodríguez Núñez.

Identification of the article:

DOI: 10.5603/CJ.a2018.0073

PMID: 30009374

Identification of the journal:

Cardiology Journal

ISSN: 1897-5593

Electronic ISSN: 1898-018X

Impact Factor 2017: 1,339

Quartil / Research area: Q2 / Cardiology and Cardiovascular Medicine.

Doctoral student contributions

The doctoral student took part in the study design. Also, she planned the training day timeline and formative activities.

As well, she participated in theoretical contents developing.

Over hands-on session, she was one of basic life support instructors and taught AED use to participants.

Together with her colleagues, she carried out the data collection over fieldwork and the coding of the data obtained. She performed the statistical analysis by SPSS.

Lastly, she wrote the paper according to Journal´s instructions.

4.3.1 Evidence of quality.

Citations up to December 2018:

1. Nadolny K, Bujak K, Kucap M, Trzeciak P, Hudzik B, Borowicz A, et al. The Silesian Registry of Out-of-Hospital Cardiac Arrest: Study design and results of a three-month pilot study. Cardiol J [Internet]. 2018 [citado 6 de dic de 2018];0. Disponible en: https://journals.viamedica.pl/cardiology_journal/article/view/CJ.a2018.0140. (102)

2. Smereka J, Iskrzycki Ł, Makomaska-Szaroszyk E, Bielski K, Frass M, Robak O, et al. The effect of chest compression frequency on the quality of resuscitation by lifeguards. A prospective randomized crossover multicenter simulation trial. Cardiol J. [Internet]. 2018. [citado el 6 de dic de 2018]. Disponible en: https://journals.viamedica.pl/cardiology_journal/article/view/60115. (103)

3. Majer J, Smereka J, Puslecki M, Szarpak L. Which technique for resuscitation physicians should use? Preliminary data. Am J Emerg Med. [Internet]. 2018. [citado el 6 de dic de 2018]. Disponible en: https://www.ajemjournal.com/article/S0735-6757(18)30730-7/fulltext. (104)

Recommended as *Interesting Reading* in European Resuscitation Council August 2018 Newsletter.

Journal subjective evidence of quality.

Cardiology Journal is a scientific, peer-reviewed journal covering a broad spectrum of topics in cardiology. The journal has been published since 1994 and over the years it has become an internationally recognized journal of cardiological and medical community.

4.3.2 Article abstract including main results.

Aim: To assess future schoolteacher´s BLS knowledge and willingness to include this content in school lessons and also to determine the learning effect of a brief BLS hands-on training session, supported by real-time feedback.

Methods: A convenience sample of 98 University students of Educational Sciences and Sports were recruited. The training program consisted of a brief theoretical and hands-on interactive session with 2/10 instructor/participants ratio. Knowledge and willingness were assessed by means of a survey. Chest compressions and ventilation quality were registered in 47 cases during 1-minute CPR tests.

Results: The study included 98 Physical Activity and Sports Science students. Fifty-nine (62%) participants declared to have been trained in CPR before the study.

All participants affirmed to know what CPR is and 58% declared to know how to perform an adult CPR.

CPR quality standards knowledge was poor firstly but, after training, knowledge improved in all concepts [chest compression/ventilation ratio, compression rate and compression depth].

The percentage of participants who knew what an AED is increased from 87.8% before training to 100% after training, also the number who declared to know how to use an AED (pre-test 38.8% vs. post-test 100%). Most subjects declared the willingness to use an AED in an eventual emergency both pre-test (70.4%) and post-test (98%).

Eighty-five percent of sample considered than a specific First Aid subject is important for their academy training and 78.6% stated that this subject should be mandatory. Most of them would be willing to include this content in projects or didactic units with their students (pre-test 71.4% vs. post-test 76.5%).

During one-minute test, more than 80% of chest compressions (CC) were performed at an adequate rate and all were delivered with correct hand position. Mean compression depth goal (50-60mm) was achieved by both, men and women groups. Full chest recoil was better in women (Women: 72.2 + 32.8% vs. Men: 45.4 + 32.9%, p=0.009) and men group performed deeper CC (Men: 56.1 + 4.03 mm vs. Women: 52.17 + 5.51 mm, p=0.0079).

No significant differences were observed regarding prior CPR training of participants.

Conclusions: Brief hands-on training supported by real-time feedback of CPR quality helps future schoolteachers improve their knowledge, self-confidence and CPR skills. BLS training should be implemented in university curricula for schoolteachers in order to promote their engagement in effective BLS training of schoolchildren.

Limitations: The test was carried out under simulation conditions and with manikins instead of real patients, thus results are probably not the same as those that would be obtained in a real situation. Anyway, it is evident that this kind of studies cannot be conducted with real victims. Participant´s knowledge and skills were assessed immediately after training, therefore we couldn´t determine the usefulness of this training for short- or medium-term retention.

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Schoolteachers as candidates to be basic life support trainers: A simulation trial.

https://www.ncbi.nlm.nih.gov/pubmed/30009374

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5. COMPLEMENTARY RESULTS

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5. COMPLEMENTARY RESULTS.

5.1 Article 4 (letter)

Original title:

Brief training in automated external defibrillation use for person with down syndrome.

Authors:

Cristina Jorge Soto, Roberto Barcala Furelos, Candela Gómez-González, Pilar Leboráns Iglesias, Isabel Campos Varela, Antonio Rodríguez Núñez.

Identification of the article:

DOI: 10.1016/j.resuscitation.2017.01.012

PMID: 28130093

Identification of the journal:

Resuscitation

ISSN: 0300-9572

Impact factor 2017: 5,863

Quartil / Research area: Q1 / Emergency medicine.

Doctoral student contributions

The doctoral student took part in the study design. Also, she planned the training day timeline and formative activities.

As well, she participated during training session as basic life support instructor and taught the AED use to participants.

Together with her colleagues, she carried out the data collection over fieldwork and the coding of the data obtained.

Lastly, she wrote the paper according to Journal´s instructions. As corresponding author, carried out the corrections and revisions requested by the Journal and sent all the documents required for publication.

5.1.1 Evidence of quality.

Citations up to December 2018:

1. Abelairas-Gómez C, Gómez-González C, Leboráns-Iglesias P, Álvarez-Pérez S, Corrales A, López-García S, et al. Down syndrome people capable of learning and performing foreign body airway obstruction treatment algorithm. Am J Emerg Med. 2018;36(11):2117-8 (48).

2. Fernandez-Mendez F, Saez-Gallego NM, Barcala-Furelos R, Abelairas-Gomez C, Padron-Cabo A, Perez-Ferreiros A, et al. Learning and Treatment of Anaphylaxis by Laypeople: A Simulation Study Using Pupilar Technology. BioMed Res Int [Internet]. 2017 [citado 20 de oct de 2018]. Disponible en: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5516735/ (101)

Journal subjective evidence of quality.

Resuscitation is a monthly international and interdisciplinary medical journal. This journal is the only that is focused entirely on cardiac arrest and cardiopulmonary resuscitation.

Resuscitation is the official journal of the European Resuscitation Council. The ILCOR and ERC consensus on science and treatment recommendations on resuscitation and ERC Resuscitation Guidelines are released through this journal.

5.1.2 Article abstract including main results.

Aim: To assess young Down Syndrome people defibrillation skills after a very brief and simple training program.

Methods: We invited member and staff of the Down Compostela Foundation to participate in a brief training program consisted on: 5 minutes easy lecture, short funny video watching and 20 minutes hands-on training. After training, every participant was tested individually in a simulated scenario, performance was evaluated by means of a check list which included three main issues: time to defibrillation, defibrillation objective, quality objective.

Results: Thirty-nine participants were included, 27 Down Syndrome (DS) young people and 12 occupational therapist (OT) subjects. DS people were 52% male, and had a mean age of 26,4 + 5,3 years. OT group were 92% male and had a mean age of 43,8 $\pm$ 17,6 years. Groups were significantly different by age and sex ($p < 0,001$).

All OT people and 17/22 (63%) DS participants accomplished the defibrillation objective [$p = 0,014$]. Quality objective was obtained by 11 (91,6%) OT people and 8 (47%) DS participants ($p = 0,013$). Time to defibrillation was 50,3 $\pm$ 8 seconds in the OT group and 74,5 $\pm$ 15 seconds in the DS group ($p < 0,001$).

Conclusions: After a simple and brief training, most of DS young people are able to use an AED device in less than two minutes, although they don't achieve the same level of performance of other citizens.

Limitations: Participation was voluntary; thus, a possible selection bias could be present if the most well-functioning DS people were volunteering. In this sense, our results only refer to well-functioning DS subjects and not to those with severe disabilities. Also, our results may be biased by the innovative and non-validated training methodology applied.

Brief training in automated external defibrillation use for person with down syndrome.

https://www.ncbi.nlm.nih.gov/pubmed/28130093

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6. DISCUSSION

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6. DISCUSSION.

Schoolchildren have been pointed out as an essential target group for BLS training and for increase bystander CPR (14,34,75,78,79, 105). However, this sample have not been studied in a widespread way and it is not clear at what age schoolchildren are capable of learning different aspects of first-aid like AEDs use and how is their background knowledge on the subject or which professional is more suitable to lead this training.

Regarding knowledge, we did not find prior references about schoolchildren AED knowledge at the time we developed the present research. Our study (*Aprendizaje del uso del desfibrilador semiautomático mediante métodos audiovisuales en escolares*) (106), the first one to present this topic, shows that 3 of every 4 participants stated to know what an AED is, despite any of them had been trained in AED previously. Currently there are some studies evaluating AED knowledge in school population. As a study conducted in Singapore, published in 2018. This study evaluated the reasons why students aged 11 to 17 years-old would be willing or not to use an AED, but did not analyse participants' AED level of knowledge (105).

Watanabe et al. found in a study published in 2017 that only 15% of 8th degree students (aged between 13-14 years old) knew what an AED was. In the practical test, only one student asked for an AED in the CA simulated scenario (107). The test used to assess participants' knowledge also included a question about the correct AED execution order and the situation where it should be used. This study was carried out with a small sample [41 participants] and all the students belonged to the same school, in contrast to our multicentre research which counts with a large sample.

Nowadays BLS/AED messages appear in the media, movies, internet videos, etc. (108) and AEDs are present and visible in public places such as airports or shopping malls. Then, it is possible that a significant number of children have acquired some indirect learning (from parents or peers but also from exposure to the use of AEDs in television/movies or by the simple observation of the devices in public places) about the relevance of early defibrillation and the bases of AEDs use. This fact is very relevant because means that the AED is a known device for Spanish schoolchildren and could entail a starting point for training.

AEDs simple design allows them to be used by anyone effectively and safely without the need of prior training.

The study "*Automated external defibrillation skills by naïve schoolchildren*" (109), the first to assess the intuitive AED use in a large sample (1295 untrained schoolchildren) with a wide age range (from 6 to 16 years of age), showed that only 8.7% of the 6-years-old pupils applied the AED correctly; around 25% of the 9-year-old group achieved the goal and this percentage increased up to 33.3% for the 16-year-old group. Regarding the quality, in the subgroups who achieved the defibrillation goal, only 11.1% of the 6-years-old group performed the test without errors, whereas almost 25% of the subjects in the 10-year-old group and more than 50% in the 16-year-old group achieved the quality objective. Thus, study results indicate that from the age of 9, one of every 4 schoolchildren are capable of applying the AED intuitively, and at the age of 16 half of the capable students are able to complete the procedure with quality. According to our results, children from 9 to 14 years have similar level of knowledge and skills to use an AED, and this suggest that around 9 years old might be the age which children should start to be trained in the use of AED, adapting the training and retraining activities to the characteristics of different age kids (110).

Attending incidences or errors, the most frequent error was the incorrect order of execution. Other errors were related to incorrect positing of pads. These facts should be considered by the instructors in order to reinforce training and overcome these common errors.

Previous studies, carried out in other countries with smaller groups of subjects, have revealed comparable results. In 1999 Gundry et al. compared the AED use by untrained schoolchildren (around 9 years old) with emergency professionals´ performance and they observed that all subjects demonstrated appropriate pad placement and safety during shock delivery (111). In another study which involved 47 naïve school children between 6 and 7 years of age (112), eight pupils (17%) identified AED execution order correctly, and after a week of BLS training by health workers the number of pupils increased up to 24 [51%]. The AED use by very young untrained children was assessed by Lawson et al. and found that 9 years-old schoolchildren naïve in AED use were able to perform AED successfully before training and time to delivery of first shock was reduced after training (113). Younas et al (60) observed that students (13-16 years of age) who had some prior academic training in first-aid obtained better results than untrained students (control group) for all evaluated skills: (1)

checking for consciousness and breathing, (2) CPR, (3) AED use. AED use was the worst performed part of the algorithm (27% training students vs. 4% control group).

Thus, our study and previous (60,106,109,111-114) support the idea that although untrained young people can use the AED, simplified training programmes may be necessary for improve AED performance and in helping young users to act under the pressure and anxiety of emergency situations.

We were surprised by the limited competence of younger kids, who should be familiar with the handling of technological devices, to follow the instructions provided by an AED. There is a chance that the problem is not the pupils´ capacity but the design and/or instruction of AEDs, that have been developed considering an eventual adult rescuer and not a child. In this sense, perhaps, alternative AED design or instructions ought to be explored. In addition, AED simple design, supports that time spent on AED in training programmes should be limited, leaving more time for other aspects which result more complicated like chest compressions (114-118).

Every minute that passes after a CA without defibrillation, chances of survival decrease by approximately 10-12%, whereas survival rates significantly increase when AED is applied within the first minutes after the collapse (8). In the sample of intuitive AED study, defibrillation time was shorter than 3 min in all cases and decreased as children´s age increased (6-year-old: 108.3 seconds vs. 16-year-old: 64.7 seconds). Importantly, all children older than 8 years finished the test in less than 2 minutes time. Immediately after a very brief training (formative video), defibrillation time decreased under 70 seconds in both, control group and experimental and under 55 seconds one month after training. Thus, defibrillation time decrease after a very brief training but also with the repeated use (119).

People with Down syndrome are increasingly integrated into society and strive to demonstrate their capabilities and to be considered like any other citizen. In this sense, they are a population willing to learn and be useful to society.

In the study which assess young Down syndrome skills, 63% of participants were able to accomplish an effective defibrillation after taking part in a brief training and 47% of them did it with quality. Time to

defibrillation was around 75 seconds (49). Other handicapped population have been studied in relation with their BLS skills, as a contemporary study which involved twenty-seven blind volunteers (115). This study shows that, after one-hour hands-on adapted training program, 20 out of 27 (74.1%) could give an effective shock in a mean time of 65 ± 27 seconds.

Our results are similar to previous data published by Gundry et al (111) although in their study participants received some indications about AED management before performing the practical test. Other study conducted in 9 years old schoolchildren showed 60 seconds defibrillation time before training and around 35 second after two minutes expert lecture (113). This suggest that schoolchildren and young people might have an intuitive idea of the importance of the factor time in the case of CA and early defibrillation (117).

Layperson CPR training is essential to increase bystander CPR rates and OHCA outcomes (45,46,118). Moreover, it is worth remembering that teaching how to act in life-threatening situations, including CA resulting from myocardial dysfunction or arrhythmias, is a key element of public safety (117).

Although schools are seen as an ideal environment to involve citizens in BLS training, it is not clear however, which professionals are more suitable for teaching schoolchildren (55,74,119).

In the study "*Schoolteachers as candidates to be basic life support trainers: A simulation trial*" (88), it was found that a very brief BLS training program had a positive effect on Physical Activity and Sports Science student´s knowledge and willingness to include this topic in school lessons.

In spite of more than half of the sample (60.2%) having declared to have received prior CPR training, less than 25% knew the correct CPR quality standards (CC per minute and CC depth). After a brief training hands-on practice with quality feedback, most of them were able to perform CPR that fulfils quality standard goals.

Results are comparable with those obtained by Bogle et al (120) in a survey responded by 267 university students (only 46% met CPR quality standards). A survey answered by 395 Spanish university students of educational science shows that 185 (46.8%) participants stated they felt capable of perform CPR but only 7 (3.8%) knew the quality standard goals and 28 (7.1%) did not know what an AED is (121)

In countries where CPR is a mandatory part of school curriculum, bystander CPR is performed in more than 40% of OHCA and has been associated with double to triple survival rates (117). The need of certified instructors could mean a practical and financial barrier for BLS training implementation. Thus, BLS training conducted by teachers could help to overcome this barrier.

Prior studies have shown that primary school teachers, previously trained by professional instructors can teach BLS effectively (55,73,74,83-86,120-122).

Most of the participants (93%) of our study considered that First Aid training is important for their education, more than 90% though their academic curriculum should include this specific subject and for 78% it should be mandatory.

Thus, for future teachers, a good BLS training during their academic education seems to be relevant and could improve their self-confidence and willingness (88).

To include these contents in university student curricula could ease implementation of strategies that endorse the role of teachers in school BLS training as Kids Save Lives initiative (67-76) or ANXOS (77).

Lukas et al. (74) have shown that BLS training provided by trained teachers is as effective as the training provided by emergency physicians, additionally, schoolchildren trained by teachers accomplished better knowledge marks. It can be assumed that teachers have practical expertise in youngster education and can obtain better results than instructors with a non-educational background. The use of school teacher staff for BLS training has many advantages, such as to ease the implementation of this instruction at school centres, to act as a role models and to act as facilitator of instruction (70,74). In the last several years self-instruction models like Relieve Game proposed by Semeraro et al (70) have been seen as relevant for schoolchildren training; in this kind of training, teachers act as facilitators or guide for instruction but they do not play the trainer role.

Regarding children capacity, they are physically and emotionally able to perform BLS (87,123-125). These abilities make schoolchildren potential instructors who can lead BLS training. Thus, a prior study found that students who were trained by peer-instructors showed comparable skills in BLS of those students who were trained by professional instructors (126). As well as, trained schoolchildren could act as multipliers with their relatives or friends (82,127). In this way, seems that for every child-instructor 1.7 people changed their attitude towards bystander CPR

positively, this is important because as a recent survey which involved 638 high-school students have reported, only 31.9% were willing to apply an AED consistently and only 43% to perform mouth-to-mouth resuscitation (128). Stroobants et al. also found better results with trainees from primary schoolchildren than with trainees from secondary schoolchildren (129).

The aim of these projects (67-76) is to ease BLS school training implementation and to overcome possible barriers which could prevent from accomplish this goal. Free and brief training adhered at public events are a feasible way to increase knowledge and skills of potential bystander (130, 131). One useful strategy is to design and carry out very brief and simple training programs compatible with school curriculum.

Very brief training programs could be an effective formative strategy for both adults and schoolchildren and seem to be as effective as courses of more than one day´s duration (131).

Thus, 45 minutes training appears to be enough for 8th grade students to improve their CPR and AED knowledge and skills (107). This knowledge and skill retention were maintained for 2 months, getting worse at 4 months for participants who had not retrained previously; this fact endorses the importance of periodic re-training (132,133). A contemporary study has shown how opportunistic 5min CC feedback training was, and whether it was enough for laypeople to be able to surpass a 70% goal for most of the technical parameters in 2 min CC test (59).

Kelley et al. demonstrated in a prior study how with a focused, 1 hour condensed training program which can be inserted into a school curriculum, eight grade students [around 13 years-old] proficient in continuous chest compressions and AED use and retain knowledge and skills four weeks later (134).

For university students, a 2 hours theoretical and practical training seems to be enough in order to improve the performance in a CA simulated scenario (88).

All the training programmes carried out in these studies meet the features of the very brief trainings. Thus, for Schoolchildren learn AED use, to visualize a formative video was the one training activity carried out. This strategy is simple and can be applied in any environment, it seems to be useful to get good results in terms of acquiring skills in BLS (29,135), but is not enough to achieve optimal quality (136). Regarding AED use, our results indicate that a short video with an attractive format for young students is very useful to use the device effectively.

In the Physical Activity and Sports Science student sample, brief training with quality feedback was effective in accomplish a mean compression rate and depth quality standard as well as correct hands position. Observations revealed that a training session lasting less than 2 h (30 min theory and 1hour hand-on practice supported by quality feedback) was enough to improve CPR performance of 85 % subjects involved.

For Down syndrome sample the training program design was very similar, including a five minutes easy lecture, formative video and 20 minutes hands-on training. Our results show that after an innovative and simple training approach, persons with DS are capable to perform simulated defibrillation with AED in less than two minutes, a time compatible with the concept of immediate defibrillation in case of OHCA.

School age could be the most suitable to start BLS training (65-76). Despite, society have not become aware of the importance to start training at early age already. Lockey et al. (137) pointed out in 2013 that only few countries have included these lessons in school curriculum, even when published studies had shown that schoolchildren are able to learn and retain BLS skills as well as or better than adults do (138). In 2018, education CPR is a legislation in 5 European countries and a suggestion in 23 (67) according to a survey answered by 31 European countries and also, most USA states require high school students to learn CPR in order to graduate. The implementation of BLS training programmes in schools is related to greatest early defibrillation rates in OHCA (139).

Although it is not clear at what age schoolchildren are capable of effectively learning different aspects of First Aid, previous studies have pointed out that the age of 13 is the minimum age to be able to perform CPR with a similar quality to an adult (114). Whereas around 9 years old, children can start to be trained in the knowledge and use of AED (106,197).

Early BLS training have been endorsed by international initiatives in the last years, like Kid Save Lives. Kids Save Lives join statement, which recommend 2 hours per year of CPR training from the age of 12 (67-76), was endorsed by WHO in 2015 (75). This project suggests the implementation of mandatory education of schoolchildren in resuscitation all over Europe and to support and secure this by nation laws (68,71). Kids Save Lives encourages practical training better than theoretical only, tools like serious game to spread CPR knowledge and improve CPR skills in

children (70) and teacher's role in BLS training, which are agree on the basis of this compendium. Starting at a young age, children will not forget how to save a life and survival rate of people with OHCA could improve by the factor of two fourfold (73). This endorsed the idea that training schoolchildren is a good investment for the present and future public health (137).

As shown in the thesis, school-teachers´ training and the implementation of BLS school training does not require either large material resources or expert staff, it is the willingness of teachers and the motivation of research groups that allows initiatives such as the proposal to become a reality. The joint work of school teachers with the scientific community could allow to design training programmes increasingly adapted to the students to whom they are addressed and better adapted to the school curriculum, in order to ensure that life-support training in the school is not something exceptional but a common reality for the entire educational community.

7. LIMITATIONS

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7. LIMITATIONS.

The present studies have some limitations.

All the tests were carried out under simulated conditions so results are probably not the same as those that would be obtained in a real situation where feelings such as stress or anxiety can affect the ability to take decisions and perform BLS.

For three studies ("*Aprendizaje del uso del desfibrilador semiautomático mediante métodos audiovisuales en escolares*", "*Brief training in automated external defibrillation use for persons with down syndrome*", "*Schoolteachers as candidates to be basic life support trainers: A simulation trial*"), sample was recruited from the same centre, thus we cannot completely discard some selection bias that would limit the generalization of results. The lack of diversity within these study populations could also be considered a limitation to the application of results to other populations.

Regarding Down syndrome sample, all participants belong to the same Foundation, it is possible that this group count with educational resources different as those available in other foundations or institutions. These participants have the same education level by the same teachers and have participated in the same extracurricular activities. This means that this sample has very specific characteristics that could make it not comparable with other groups.

Although we asked if schoolchildren knew what an AED is, we did not verify where schoolchildren had learned from or what kind of education they may have had. This point was not considered in the initial design of the study but authors feel now that a questionnaire explaining how kids had learned about AED would add some relevant information to the study.

One of our goals is to insert the AED training programme into a typical school day without disruption of the general curriculum. In the schoolchildren training, the video was viewed individually and in a different room from the classroom where classes are held daily. This could mean ideal conditions for learning, without interruptions or distractions

derived from the normal development of a class. This can affect the effectiveness of the formative activity, it would be interesting to visualize the video in a group way in the classroom and then evaluate the usefulness of this formative activity.

8. CONCLUSIONS

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8. CONCLUSIONS.

1. The AED is a device known by a significant percentage of the school population and the school stage is significantly related to AED knowledge, which is better in secondary students.

2. Currently around 20% of theoretically naïve schoolchildren are able to apply an AED in less than 3 minutes by means of their general knowledge and device´s acoustic and visual instructions. However, children´s background knowledge and AED instructions alone are not enough to perform the procedure satisfactory. These facts should be considered to define and implement effective BLS/AED teaching and training at schools.

3. Defibrillation skills improve with age. Secondary students perform better AED use and they apply the shock in a shorter time than primary schoolchildren.

4. The visualization of a simple and brief formative video is useful for schoolchildren improve AED use and contributes to short-term retention of learnt skills. We suggest to include this formative tool in scholar curriculum and to apply it in a repetitive way together with other teaching activities.

5. After a simple and brief training, most of Down syndrome young people are able to use an AED device in less than two minutes, although they don't achieve the same level of performance of other citizens. Looking to the future, public access defibrillation programs should be offered not only to standard population but also to handicapped people.

6. Brief hands-on training supported by real-time quality feedback helps to improve knowledge and self-confidence in BLS and CPR skills of future schoolteachers. BLS training should be implemented in the University curricula for schoolteacher to promote the engagement of these professionals in effective BLS training of schoolchildren as supported by initiatives such as Kids Save Lives.

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9. POSSIBLE INFLUENCE ON FUTURE GUIDELINES FOR RESUSCITATION

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9. POSSIBLE INFLUENCE ON FUTURE GUIDELINES FOR RESUSCITATION.

Currently, Guidelines and formative projects which try to spread BLS training like Kid Save Lives endorsed that schoolchildren BLS training should starts at the age of twelve years old. According to our results, children from 9 to 14 years old have similar level of knowledge and skills for AED use; this suggest that around 9 years old might be the age at which children should start to be trained in the use of AED, adapting the training and retraining activities to the characteristics of kid´ school level.

We consider that future Guidelines for Resuscitation should take into account this data and endorse the recommendation of start AED training as soon as possible. Based on our results we suggest the age of 9 as the latest when this formation should start.

Early AED training joined-up placement defibrillator in public places could improve familiarize schoolchildren with this device.

The scientific community recommends that the entire population should be trained in BLS. We strongly support this idea and therefore consider that people with some kind of disability or impairment should not be excluded from this training.

In our study and in other contemporary studies, it has been shown that people with Down syndrome are able to learn how to perform chest compressions and to use a defibrillator correctly after a very brief training essentially practical.

The training programmes that have been used for them are the same as those applied to the general population with minimal variations to facilitate and reinforce learning based on the characteristics and capacities of our study population. It would be interesting for future Guidelines for Resuscitation to reinforce this idea, including proposals for training strategies aimed at different handicapped populations.

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10. FUTURE PERSPECTIVES OPEN BY THIS RESEARCH

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10. FUTURE PERSPECTIVES OPEN BY THIS RESEARCH.

After to analyse the obtained results related to schoolchildren AED knowledge, we realise that this device is not unknown for scholar and young population.

In the study design we did not consider the possibility that schoolchildren without specific training in BLS could know the defibrillator or have an idea of what it is used for.

For this reason, our questionnaire did not include any questions about the source of this prior knowledge.

Currently, we are designing a study that we will carry out over the next year where we will evaluate where this indirect knowledge that schoolchildren have acquired about the defibrillator, cardiac arrest and the importance of the time factor in the attention to this event comes from. Our initial premise points to television and films as the element that has spread this knowledge among the young population, but we do not reject other media such as video games or social networks.

As a result of our experience training young people with Down syndrome and after the good results we obtained in terms of acquiring knowledge and skills both in CPR and in the use of the AED, we have continued to direct our training activities to other handicapped populations as visual impairment people.

In the last 2 years we have conducted BLS training for small groups of adults with some type of visual impairment, both total and partial blindness. The methodology we have followed has consisted of putting into practice very brief and fundamentally practical training programmes in the same way as is done with non-disabled populations. The main feature of our training programme was that the participants were always in touch with the training material (mannequin and training defibrillator). Therefore, in this activity, touch has been given special relevance as a means for participants to understand each step of the BLS.

This study assessed the performance of BLS algorithm in case of an adult CA, quality of chest compressions and AED use.

This project and the preliminary results were presented to the scientific community during the ERC Congress in 2017 by means of an oral communication (140).

Recently, the results obtained from the whole sample have been published in Resuscitation Journal (115).

In these formative programs, after training and the practical test, we requested our participants to fill out a survey about perceived difficulty in the use of the defibrillator and proposals for improving the design of current defibrillators.

After evaluating the answers obtained, during this last year we have designed and developed an adhesive template to create defibrillators adapted to visual impairment people.

The template is black and covers only half of the front face of the defibrillator. It has two main elements: numbers from 1 to 3 and 4 words (on/off; wait; press). The words are in Spanish and in sign language also. All the elements of the template have relief, so they can be perceived by touch.

This prototype was presented in the last ERC Congress, which took place in September 2018 in Bologna (Italy) (50)

Our next step is to test this adapted defibrillator and to compare the visual impaired people performance in order to assess the usefulness of this new device.

Image 6: Adapted defibrillator for visual impairment prototype.

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SUPPLEMENTARY MATERIAL

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APPENDIX I: Questionnaire on first aid and CPR knowledge. Used in the study "*Schoolteachers as candidates to be basic life support trainers: a simulation trial*"

CUESTIONARIO SOBRE LOS CONOCIMIENTOS EN PRIMEROS AUXILIOS Y LA RCP

Sexo

☐ Mujer

☐ Hombre

Edad: _____

Provincia de la C.A. de Galicia dónde realizas o has realizado tus estudios: _____

Titulación: _____

Curso académico realizado en 2013/14: _____

1. ¿Has recibido alguna vez formación en primeros auxilios?

☐ Sí

☐ No

2. Si has recibido alguna clase de primeros auxilios o recomendaciones de lo que deberías hacer en caso de que ocurriese un accidente. ¿Dónde fue?

☐ En una asignatura específica de primeros auxilios o socorrismo de la universidad

☐ En una parte de alguna asignatura de la universidad

☐ En otra formación oficial (máster, postgrado, F.P., título deportivo)

☐ En un curso no oficial (cursos de empresas, cursos de socorrismo, cursos primeros auxilios)

☐ Otras (congresos, jornadas, seminarios)

☐ No he recibido ningún tipo de formación

3. Número de horas recibidas de formación en primeros auxilios:

_____

4. ¿Consideras que aprender primeros auxilios es importante en tu formación?

☐ Totalmente en desacuerdo

☐ En desacuerdo

☐ Ni de acuerdo ni en desacuerdo

☐ De acuerdo

☐ Totalmente de acuerdo

5. ¿Sabes qué es una RCP?

☐ Sí

☐ No

6. ¿Sabes realizar una RCP en adultos?

☐ Sí

☐ No

7. ¿Cuándo has realizado el último entrenamiento de RCP?

☐ En los últimos 3 meses

☐ Entre los últimos 4 y 6 meses

☐ Entre los últimos 7 y 12 meses

☐ Hace más de 1 año

8. ¿Has recibido formación o realizado entrenamientos de RCP con feedback?(RCP con feedback: se consideran mecanismos que ayudan e informan sobre la ejecución y calidad de la RCP)

☐ Sí

☐ No

9. Opinas que tu entrenamiento de RCP con feedback fue:

☐ Muy eficaz

☐ Eficaz

☐ Suficiente

☐ Pobre

☐ Muy pobre

10. ¿Has realizado la RCP en una situación de emergencia?

☐ Sí

☐ No

☐ No, pero fui testigo

11. En caso afirmativo, ¿cuántas veces con intervención directa tuya?_____

12. ¿Cuántas veces como testigo? _____

13. ¿Cómo calificarías tu habilidad para realizar la RCP?

☐ Muy eficaz

☐ Eficaz

☐ Suficiente

☐ Pobre

☐ Muy pobre

14. En una RCP para adultos ¿cuál es el ratio compresión/ventilación?

- ☐ 15-2
- ☐ 30-2
- ☐ 50-1
- ☐ No sé

15. En una RCP para adultos ¿a qué ritmo deben realizarse las compresiones?

- ☐ 60-80 compresiones por minuto
- ☐ 80-100 compresiones por minuto
- ☐ 100-120 compresiones por minuto
- ☐ No sé

16. En una RCP para adultos ¿cuál es la profundidad a la que se debería comprimir el tórax?

- ☐ Entre 1 y 3 cm
- ☐ Entre 4 y 5 cm
- ☐ Entre 5 y 6 cm
- ☐ No sé

17. ¿Sabrías realizar una RCP en niños?

- ☐ Sí
- ☐ No

18. En una RCP para niños ¿cuál es el ratio compresión/ventilación?

- ☐ 5-1
- ☐ 15-2
- ☐ 30-2
- ☐ 50-1
- ☐ No sé

19. En una RCP para niños ¿a qué ritmo deben realizarse las compresiones?

- ☐ 60-80 compresiones por minuto
- ☐ 80-100 compresiones por minuto
- ☐ 100-120 compresiones por minuto
- ☐ No sé

20. En una RCP para niños ¿cuál es la profundidad a la que se debería comprimir el tórax?

- ☐ Entre 1 y 3 cm
- ☐ Entre 4 y 5 cm
- ☐ Entre 5 y 6 cm
- ☐ No sé

21. Si tuvieses conocimientos de primeros auxilios y RCP, ¿lo incluirías en proyectos o unidades didácticas con tu alumnado?

- ☐ Totalmente en desacuerdo
- ☐ En desacuerdo
- ☐ Ni de acuerdo ni en desacuerdo
- ☐ De acuerdo
- ☐ Totalmente de acuerdo

22. ¿Sabes qué es un Desfibrilador Externo Semiautomático (DESA)?

- ☐ Sí
- ☐ No

23. ¿Sabrías usarlo?

- ☐ Sí
- ☐ No

24. ¿Lo usarías si fuese necesario?

- ☐ Sí
- ☐ No
- ☐ No sé

25. El teléfono gratuito de emergencias es:

- ☐ 061
- ☐ 112
- ☐ 911
- ☐ Otro diferente a los anteriores
- ☐ No sé

26. ¿Consideras necesaria una asignatura específica de primeros auxilios y socorrismo en tu formación?

- ☐ Totalmente en desacuerdo
- ☐ En desacuerdo
- ☐ Ni de acuerdo ni en desacuerdo
- ☐ De acuerdo
- ☐ Totalmente de acuerdo

27. ¿Consideras necesario que esta materia sea obligatoria?

- ☐ Totalmente en desacuerdo
- ☐ En desacuerdo
- ☐ Ni de acuerdo ni en desacuerdo
- ☐ De acuerdo
- ☐ Totalmente de acuerdo